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Construction and Cost Feature of Rural Lines

Report of Committee on Rural Extensions Presented Before Convention of Wisconsin Electrical Association—Vast Amount of Construction Work Required to Supply Farm Service Now Needed

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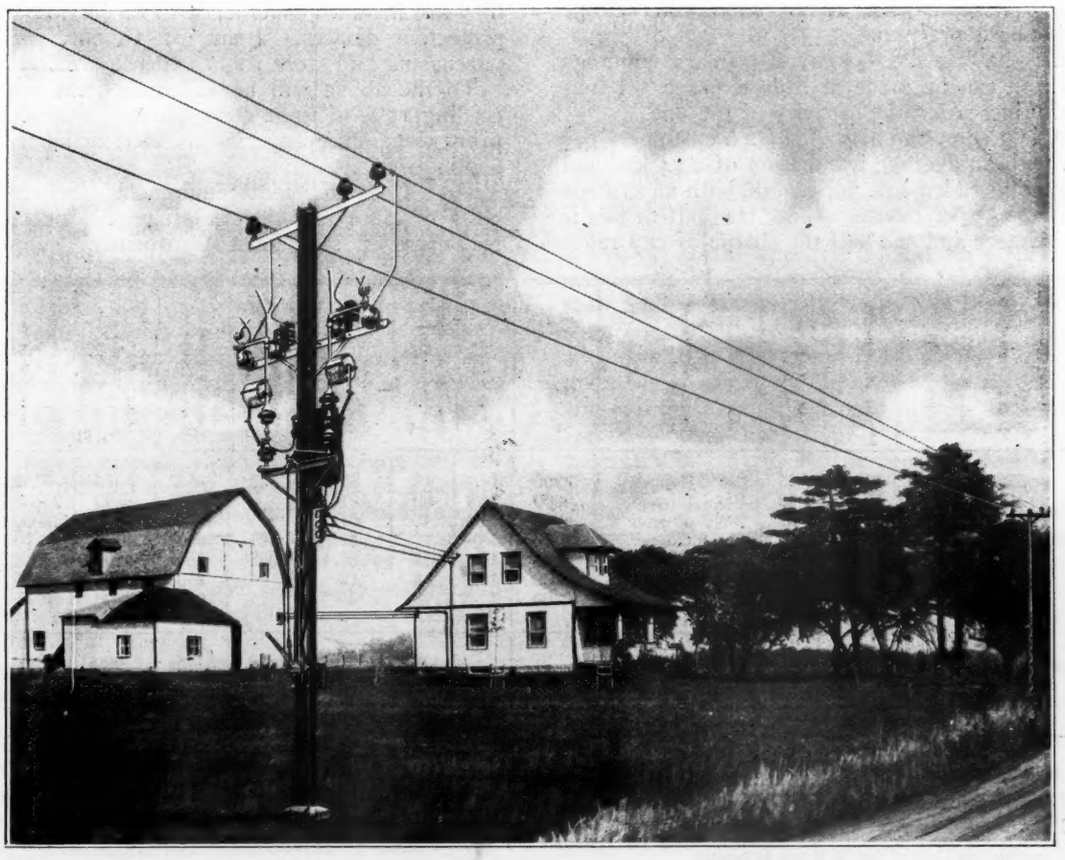
Growing demands on the part of the rural population of the country for electric service of a substantial character centered the attention of many progressive manufacturers, contractors and central station managers on this great new field. A material portion of our entire population lives in rural districts and, so far as the electrical industry is concerned, this vast population still remains practically unserved. For the time being the great problem to be met in taking service to these people centers about the construction of a network of distribution lines and the wiring of the farm homes and property. The wiring of homes is, of course, an individual matter, but the building and serving of lines is a matter involving several different people and interests, and requires the expenditure of money for construction work that does not belong directly to the individuals served. This makes it necessary to establish the rules and regulations governing



Unit-Type 13,200-110-220-Volt Farm Power and Lighting Equipment of "Delta-Star" Make.

methods of financing and construction, as well as establishing rates of service that will be equitable and permit of the full utilization of all facilities available.

The various features of the rules proposed in 1920 have been studied in the light of last year's experience, with the result that certain modifications are herein proposed. The underlying theory expressed fully in the previous report appears correct and the modifications now proposed are intended only to make the rules simpler and easier of application. The statistics gathered by the committee, as given in the following tables, should be of considerable value in fixing a basis for future calculations. They cover extensions to over 200 farmers and seem to fairly represent present conditions in Wisconsin.

Statistics Showing Various Features of Rural Construction and Service.

Table 1 shows that the eight extensions investigated were, in general, constructed of 30-ft. 6-in. top cedar poles spaced 150 ft. apart with No. 6 solid hard-drawn bare copper wire. These lines are single-phase and 3-phase, and are operated at 2200 and 6600 volts. It is believed that 2200-volt distribution should prove satisfactory for short rural lines, but that 4000, 4400 and 6600-volt distribution will be needed for the more extensive rural developments. The general tendency in electrical distribution and transmission is toward higher voltages, and this is also common to rural distribution. Companies constructing 2200-volt rural lines will do well to anticipate future requirements. Future demands for increased capacity may be met by changing to 4000-volt, 3-phase, 4-wire, or to 4400 volts either single-phase or 3-phase. By the use of transformers having 2200-4400-volt primary windings provision can be made at little expense for materially increasing the capacity of the line.

Table 3 shows an average of 2.6 customers per mile with an average installation of 2.24 kw. and consuming 32 kw-hrs. per month, with an average bill of $6.53 per month. About one-half of this is rural charge and one-half the charge of city rates. The average combined cost of general and local equipment is $476 per customer.

Proposed Rules and Rates and Discussion of Rural Service.

The accompanying definitions and rules are recommended by the committee. Following each rule are *Notes* giving explanations, comments and reasons for changes from the wording in the 1920 report. Minor changes have been made without comment.

(1) *Rural customer and rural extension defined.*—The term "rural customer" as herein used refers to the farmer or other consumer of electrical energy who is not located within the corporate limits of any city or village, or in other territory having similar character or density of population.

The term "rural extension" relates to an extension made primarily to serve rural customers.

(2) *Analysis of extension.*—When one or more prospective rural customers make written request for electric service the utility will investigate the extension, ascertain the number of customers who can be advantageously served, the number willing to contract for service under the terms herein prescribed, and will estimate the construction cost.

(3) *Construction cost.*—Construction cost shall include the following:

(a) Cost of "general equipment" includes all costs of labor and material directly chargeable to the rural extension from the point where the rural extension originates to the local equipment at the customers' premises. Where transformers are necessary to supply energy to the extension they are included together with all auxiliary and protective devices. Items of freight, cartage, purchasing and store room expense are included.

To the above will be added an item not exceeding 15% of these costs to cover engineering, promotion, office supervision, clerical labor, and contingencies.

(b) Cost of "local equipment" includes all costs of labor and material required for the installation of step-down tranformers supplying

Extension Number	Date of Construction	Length in Miles	**Poles predominating size	Poles average number per mile	*Primary wire size and material	Voltage	Phase	Step down transformers number connected	Step down transformers K. V. A. connected	Construction Cost of transformers serving extension (General Equipment)	Cost of Primary line (General Equipment)	Cost of step down transformers, transformer protection & secondary lines (Local Equipment)	Total Construction Cost (Local & General Equipment)	Number of customers connected
1	1920	4.50	30'-6"	35	No. 6 Copper	2200	1	12	35	450	3627	1375	5452	16
2	1917	23.00	20'-6"	40	3-No. 9 Iron	6600	1&3	60	121		15755	6890	22645	58
3	1917	14.00	25'-6"	32	3-No. 10 Iron	6600	1&3	45	61		10500	3550	14050	30
4	1920	5.20	30'-6"	36	No. 6 Copper	2200	1	12	34	401	5631	1199	7232	16
5	1920	7.25	30'-7"	35	No. 6. Copper	6600	1	19	28	968	7306	4800	13074	17
6	1920	2.25	30'-6"	35	No. 6. Copper	2200	1	6	12		2160	1296	3456	6
7	1920	6.37	30'-6"	35	No. 6. Copper	2200	1	18	36		6885	3890	10775	18
Total		62.57						172	327	1819	51864	23000	76684	161
***8	1919	28.00	30'-6"	35	No. 6 Copper	6600	1&3	76	239					85

*All copper conductor is No. 6 Solid hard drawn bare copper. Iron Conductors consist of three wires twisted together.

**Poles in extension No. 1, 2, 3, 7 & 8 are Northern Cedar untreated.
Poles in extensions No. 4, 5, & 6 are Western Cedar "A" butt treated.

***Construction Cost of No. 8. is not available.

Table 1.—Physical Characteristics and Construction Costs of Rural Line Extensions.

Extension Number	Number of Customers	Construction Cost All Equipment	Number of KWH Sold per Year	Annual Revenue from Rural Charge	Annual Revenue from City Rate	Total Annual Revenue	KW Connected Load Lighting & Irons	KW Connected Load (HP x ¾) Power	KW Connected Load Range	Total Connected Load-KW.	Number of years in which the revenue from city rates will equal construction cost.
1	16	5460	8460	390.00	709.00	1099.00	23.1	7.5	6.0	36.6	7.7
2	58	22645	23535	1951.00	2110.00	4061.00	61.0	85.0	0	146.0	10.7
3	30	14050	9547	1286.00	901.00	2187.00	33.0	31.0	0	64.0	15.6
4	16	7232	9300	557.00	780.00	1337.00	15.3	18.7	0	34.0	9.3
5	17	13074	4239	1249.00	466.00	1715.00	27.7	3.0	0	30.7	28.1
6	6	3456	2940	247.00	434.00	681.00	7.3	4.0	0	11.3	8.0
7	18	10775	3844	974.00	576.00	1550.00	25.7	10.0	0	35.7	18.7
Total	161	76684	61865	6654.00	5976.00	12630.00	193.1	159.2	6.0	358.8	12.8
*8	85		38652								

*Missing data for extension No. 8 is not available.

NOTE: In several of the extensions the revenue shown is calculated.

Table 2.—Construction Costs, Energy Sold, Revenue and Load Connected to Rural Lines.

the customers, together with all secondary mains, service drops, service brackets, protective devices and appurtenances. Items of freight, cartage, purchasing and store room expense are included.

To the above will be added an item not exceeding 15% of these costs to cover engineering, promotion, office supervision, clerical labor, and contingencies.

Metering equipment will be supplied by the utility at its own expense.

Note.—It seems desirable to separate the local equipment cost from the general equipment cost in order that each individual may pay for the local equipment necessary to take care of his requirements. This method of apportionment although not specified may be used under the 1920 rules.

(4) *Payment by customers.*—When the prospective rural customers pay to the utility the estimated cost of general equipment, the utility will proceed to purchase and install the same. When the above payment has been made and a prospective rural customer further pays to the utility the estimated cost of local equipment required to serve him, the utility will proceed to purchase and install the local equipment.

When local equipment serves more than one customer the utility will apportion the cost between the various users, and each customer shall pay his portion so determined.

If the actual construction cost exceeds the estimated construction cost, the prospective customer shall, upon demand, pay a part of the difference in proportion to the amount originally advanced. If the actual construction cost is less than the estimated construction cost the utility will refund the difference to the customers in proportion to the amount advanced.

Note.—Utilities should exercise care in estimating the construction cost in order that it will not be necessary to make additional collections from customers after construction is completed. Considerable difficulty may be expected where estimates are made too low.

(5) *Connecting charge for additional customer.*—An additional rural customer will be connected to an extension upon the payment of a connection charge plus the cost of the local equipment necessary to serve him.

This connection charge will be determined by dividing the total cost of general equipment of the original extension by the number of original customers.

If the cost of general equipment required to serve the additional customer is less than the connection charge the additional customer shall pay the connection charge and the cost of local equipment, whereupon the utility will make the connection. The difference between the connection charge and the cost of general equipment shall be refunded to the customers on the extension (including the additional customer) in proportion to the amounts advanced.

If the cost of the general equipment required to serve the additional customer is greater than the connection charge, the additional customer shall pay the cost of the additional general equipment required and the cost of local equipment whereupon the utility will make the connection. In this case no refunds will be made to the original customers.

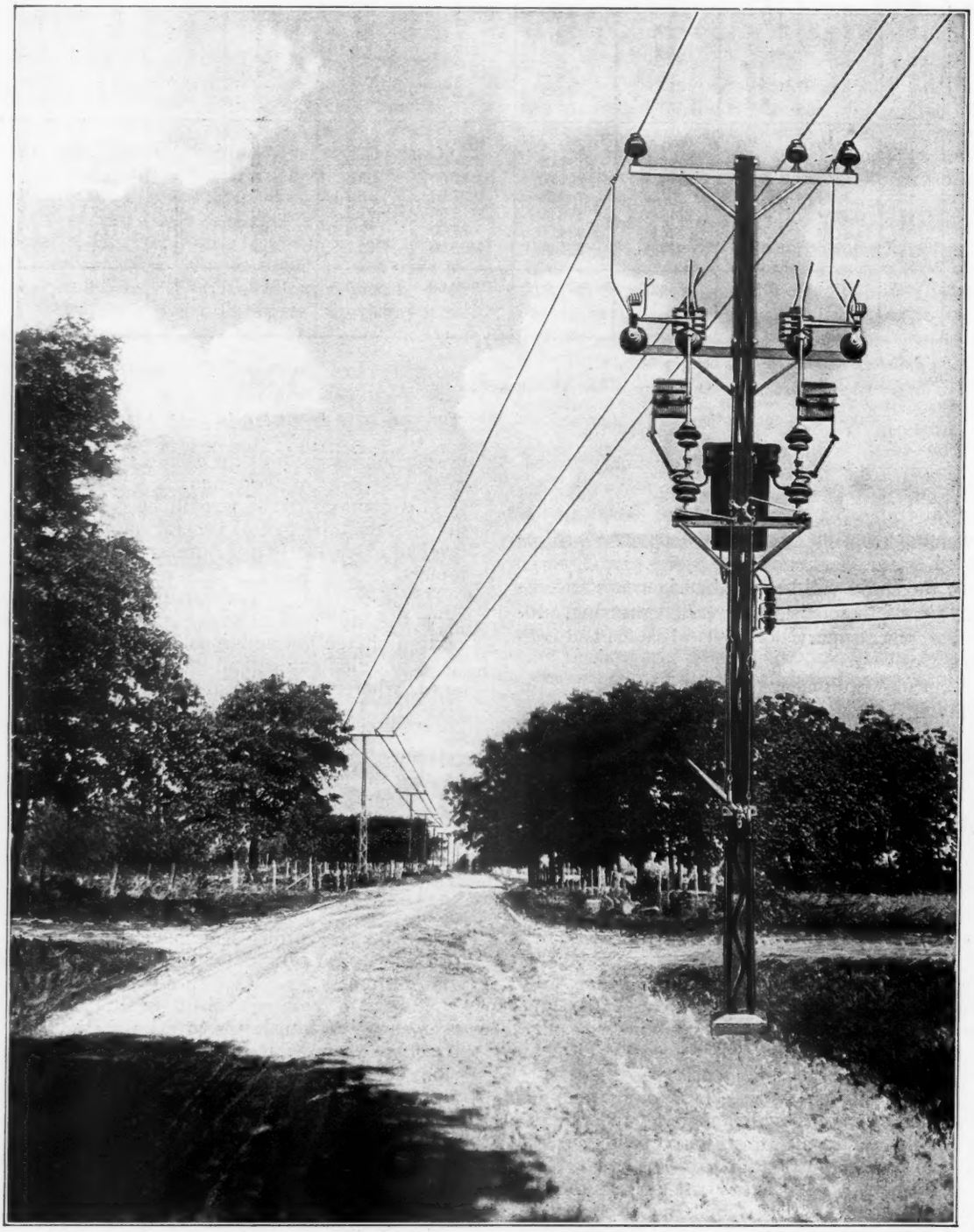
Subject to the approval of the Railroad Commission of Wisconsin the utility may, in not less than five years after the beginning of the extension, consider the development period completed and may thereafter connect additional customers upon the payment of the actual cost of the general and local equipment necessary to serve them.

Note.—The changes in this rule were made necessary in part by the division of construction cost into general and local equipment costs. The last paragraph of this rule is an addition to the previous rules and seems advisable to the committee.

(6) *Rates.*—The rates for rural service shall be: (A) A rural charge, plus (B) the regular city rates.

(A) *Rural charge.*—The rural charge shall cover the amount by which the fixed charges, energy losses and operating expenses incident to rural service exceed the corresponding items for equivalent revenue from city service.

(a) *Annual rural charge for extension.*—The annual rural charge for the extension shall be equal to 10% of the total construction cost of the extension, plus the total transformer core losses



Typical Illustration of Modern Farm-Line Construction, Showing Use of Expanded Steel Poles and Delta-Star Terminal Equipment for Installation at Customer's Premises — Capacity of 5 Kv-A. at 110/220 Volts

per year computed at the utility's cost of energy, minus 27% of the annual revenue from the extension resulting from the application of the regular city rates.

(b) *Annual rural charge for individual customers.*—The annual rural charge of the individual customers will then be determined as follows: 50% of the total annual rural charge shall be apportioned equally among the customers. 50% of the total annual rural charge shall be apportioned among the customers according to installed transformers capacity. In case two or more customers are served from the same transformer the installed transformer capacity for each customer shall be considered as the estimated portion installed for the requirements of each individual.

(c) *Monthly rural charge.*—One-twelfth of the annual rural charge so apportioned to each customer shall be billed monthly by the utility and paid by the customer as the monthly rural charge.

Note.—For a rural extension the items of depreciation, taxes, excess operating expense and hazard have been found to equal about 10% of the construction cost as follows:

Depreciation	4.0%
Taxes	1.5%
Excess maintenance and operating expense, and hazard	4.5%
Total	10.0%

The city rates are designed to cover taxes, depreciation and a return on the investment in the city distribution system as follows:

Taxes	1.5%
Depreciation	4.0%
Return	8.0%
Total	13.5%

The average investment in city distribution systems is equal to about twice the annual revenue. These fixed charges carried by city rates can therefore be expressed as 27% of the annual revenue.

The rural charge should not include any expenses covered by the regular city rates. The 10% of construction includes all fixed charges on the rural extension. It is therefore necessary in computing the rural charge to deduct the amount of fixed charges covered by the regular city rates.

The data in Table 4 confirms the 1920 assumption that the computed transformer core loss is a fair measure of the excess distribution loss in a rural extension.

(B) *Regular city rate.*—In addition to the rural charge, the customer shall pay the regular rates charged for service in the city where the extension originates. This charge will include all minimum and demand charges which are a part of the city rates.

(7) *Annual adjustment in rural charge.*—Adjustments will be made in the rural charge at the end of each calendar year to allow for changes in the number of customers, the revenue from the line, or changes in transformer capacity, and the rural charge then fixed shall be effective for the following calendar year.

Note.—In case a uniform rural charge is used as discussed later it may be desirable to omit Rule 7.

(8) *Combined transmission line and rural extension.*—In case the rural extension is constructed for use partly as a transmission line to some larger customer, city, village or hamlet, and the business to be derived from the use of the extension as a transmission line, is inadequate to justify the construction of the extension without a portion of the cost being paid by rural customers, such portions of the cost of general equipment as may be equitably apportioned to the rural business shall be paid for by the prospective rural customers. Rural customers shall in all cases pay for local equipment.

(9) *Change in equipment.*—When the capacity, size or character of any general or local equipment needs to be increased or changed in order to adequately take care of the rural service, the customer or prospective customer, whose requirements necessitate the change, shall pay for the same. Apportioning of such payments shall be the same as for new extensions.

(10) *Title to extension.*—The title to extensions toward which customers have advanced money shall be vested in the utility.

Per Mile				Per Customer											
Extension Number	Customers per Mile	Construction Cost of Transformers Serving Extension (General Equipment)	Cost of Primary line (General Equipment)	Construction Cost of transformers Serving Extension (General Equipment)	Construction Cost Primary line (General Equipment)	Construction Cost Step Down Transformers. Transformer Protection and Secondary lines (Local Equipment)	Total Construction Cost (General & Local Equipment)	Step down transformer. K. V. A.	KW. Connected lighting load including irons.	KW connected Power load.	KW Connected range load	Total connected load K. W.	K. W. H Sold per month	Monthly revenue from Rural charge	Monthly Revenue from City Rates	Total monthly revenue.
1	3.5	$100.00	$ 808.00	$28.00	$226.00	$ 85.90	$339.90	2.2	1.44	.48	.38	2.30	36.6	2.03	3.70	5.73
2	2.5		685.00		271.00	119.00	390.00	2.1	1.05	1.46	.00	2.51	28.2	2.81	3.00	5.85
3	2.1		742.00		346.66	118.33	364.99	2.0	1.10	1.03	.00	2.13	22.0	3.58	2.51	6 99
4	3.0	77.00	1082.00	25.00	351.00	75.00	457.10	2.2	.96	1.16	.00	2.12	40.3	2.90	4.06	6 96
5	2.6	133.44	1005.00	51.00	401.00	282.00	704.60	1.5	1.63	.18	.00	1.81	18.3	6.12	2.40	8.52
6	2.7		961.00		360.00	216.10	575.00	2.0	1.21	.66	.00	1.87	34.0	3.43	6.04	9.47
7	2.8		1080.00		383.00	216.00	599.00	2.0	1.42	.56	.00	1.98	15.6	4.50	2.67	7 17
Weighted Average	2.6		829.00	**	322.00	142.00	476.00	2.0	1.20	1.00	.04	2.24	32.0	3.44	3.09	6.53
*8	3.0							2.8					31.6			

*Missing Data for Number 8 not available.

**Weighted average for all extensions is 11.30.

Table 3.—Average Values of Data Shown in Tables 1 and 2.

(11) *Limitation of service.*—Individual customers appliances may be limited to a demand of 5 kw. (5000 watts or 6.66 hp.) if the characteristics of the line do not permit giving reasonably good service with larger appliances. The characteristics of all equipment connected to the line is subject to the approval of the utility.

(12) *Construction.*—Construction shall conform to good practice and shall be equal to or better than the minimum standards required by the Railroad Commission of Wisconsin. The utility is to be the judge as to the design, capacity, and construction of general and local equipment.

(13) *Extension from high-voltage transmission line.*—Rural extensions from transmission lines of over 15,000 volts will be considered special by the utility because of the operating and construction features involved.

(14) *Continuity of service.*—The customer understands and agrees that service will be furnished from a single line, and that service may be interrupted from time to time due to accident or the making of repairs. The utility will use reasonable diligence in furnishing an uninterrupted and regular supply of electrical energy.

(15) *Access to customer's premises.*—The utility shall have the right at all times to make an examination of apparatus and materials placed by it on the premises of the customer, and to make such changes and improvements as shall, in its opinion, be necessary for the proper operation of the installation at such times as may be mutually agreed upon.

(16) *Inspection of installation.*—The utility shall have the right at all times to make an examination of installation of lights, motors, and other apparatus of the customer, and it may refuse to make connection or give service unless the installation is in proper condition to receive and to utilize the same. The customer shall not make any changes in his installation which may harmfully effect the operation of the utility's apparatus without consent of the utility.

(17) *Default.*—If the customer defaults in payment of bills or fails to comply with the utility's rules after specific notice has been given, the utility may disconnect service and remove its metering equipment.

(18) *City rules.*—Rules applying to the utility's city service, except as herein modified, shall also apply in general to rural service.

(19) *Modification of these rules and rates.*—It is understood that the foregoing rules and rates may be modified from time to time, subject to the approval of the Railroad Commission of Wisconsin.

Uniform Rural Charge and Special Electric Rate.

In the 1920 report it was suggested that a rural charge be determined for each extension and that this charge be adjusted annually. Realizing that simplicity is greatly to be desired, considerable attention has been given to the possibility of applying a uniform schedule of rural charges in a specified territory or to the entire rural business of a utility. This rural charge would vary with the amount of transformer capacity installed, and would not be subject to annual adjustment but would be under the usual commission regulation. This plan has the advantage of simplicity and

Extension Number	K. W. H. furnished to extension in 1920	K. W. H. Sold from extension in 1920.	K. W. H. Loss	Percentage of Loss	Number of K. W. H input for each K. W H sold	Transformer core loss computed from Manufacturer's Data on Transformers	Total Measured loss less core loss computed on basis of Table IV	Percentage of loss in addition to computed core loss (comparable to city distribution)
2	57,080	23,535	33,545	58	2.42	18,890	14,655	25%
3	28,084	9,547	18,537	66	2.94	9,438	9,099	32%
8	78,650	38,652	39,998	51	2.04	24,820	15,178	19%
	163,814	71,734	92,080	56	2.28	53,148	38,932	24%

*In the 1920 report it was assumed that "the excess loss in rural distribution is equal to the total core losses of all transformers used in supplying the rural service." The usual distribution loss in city distribution is about 20%. The above data covering these rural lines indicates that the assumption made in the 1920 report is conservative.

Table 4.—Data Relative to Transformer Core Losses on Rural Lines.

eliminates the necessity for a special investigation to determine the rural charge for each extension.

The plan has the disadvantage that certain customers will pay a higher and others a lower rural charge than the rural charge computed on the original basis. The application of a uniform rural charge to work out successfully must be preceded by a careful survey of the territory involved, and it is recommended that this plan be used only by utilities willing to make such an analysis. For such cases, substitute the following rule for part A of Rule 6 (Rural charge):

Substitute rule for rule 6 A—Rates.—The rates for rural service shall be a rural charge plus the regular city rates, or their equivalent. The rural charge shall represent the average amount by which the fixed charges, energy losses, and operating expenses incident to rural service exceed the corresponding items for city service and shall be "*X*" dollars per month per customers plus "*Y*" dollars per month per kv-a. of installed transformer capacity.

Note.—If 50% of the total rural charge is apportioned equally among the customers and the remaining 50% apportioned among the customers according to installed transformer capacity, as defined in the 1920 report and in the foregoing, then "*X*" is equal to 50% of the average monthly rural charge determined for the territory and "*Y*" is equal to 25% of the average monthly rural charge determined for the territory, assuming a 2-kw. transformer to be an average installation per customer. The average monthly rural charge for the system made up of extensions 1 to 7 inclusive, is $3.44 and the average transformer capacity per customer is 2 kv-a. Therefore the rural charges for this system would be as follows:

1 Kv-a. transformer installation.....$2.58 per month
2 Kv-a. transformer installation.....$3.44 per month
3 Kv-a. transformer installation.....$4.30 per month
4 Kv-a. transformer installation.....$5.16 per month
5 Kv-a. transformer installation.....$6.02 per month

The 1920 report specified that in addition to the rural charge the customer should pay for service at the regular city rates. This has the advantage of employing a rate structure which is in force, bears the approval of the Railroad Commission, has been developed over a considerable period and changes automatically with city rate adjustments. This may be of some satisfaction to the rural customer. It has the disadvantage, however, of requiring some customers to have more than one meter as city rates do not ordinarily provide a schedule for combined lighting, power and heating service.

Other forms of rates have been suggested to

Size K. V. A.	2300—115 V. 230 V. Loss in Watts	6900—115 V. 230 V Loss in Watts	13800—115 V 230 V Loss in Watts
1.0	19	..	..
1.5	..	27	..
2.0	24	..	..
2.5	..	..	46
3.0	32	36	..
5.0	40	50	68
7.5	54	69	..
10.0	64	87	106
15.0	88	114	160
25.0	120	171	240
37.5	175	230	320

Table 5.—Approximate Core Losses in Transformer of Various Sizes.

admit of the use of a single meter any of which may be designed particularly for rural business. Such a rate might be an increment (block meter) rate substantially as follows:

Substitute for rule 6 B.—In addition to the rural charge the customers shall pay the following:

First 20 Kw-hrs. per month @.....$—— per Kw-hr.
Next 80 Kw-hrs. per month @.....$—— per Kw-hr.
Excess Kw-hrs. per month @.....$—— per Kw-hr.

Subject to a minimum monthly charge of

$—— per month per horse power connected motor load, plus
$—— per month per Kw. of connected lighting load, plus
$—— per month for Kw. of connected range load.

Note.—In this rate, the first step of 20 kw-hrs. is intended to cover the average monthly use of energy for lighting, whereas, the remainder of the schedule is intended to cover the use of energy for power and cooking. A rate of this kind for combined light, power and heating would have the advantage of economy in meter investment, testing, reading and billing. It would be advisable only when the utility is willing to make the necessary study in order to properly determine a rate of this kind.

In order to explain the derivation of the rural charge two calculations have been made in Tables 6 and 7.

TABLE 6—SHOWING FIGURES TO ILLUSTRATE THE REASON FOR THE RURAL CHARGE.

	City conditions.	Rural conditions
(1) Average kw-hrs. sold per year per rural customer (derived from Table 3) rural customer (derived from Table 3)	384	384
(2) Cost to customer of 384 kw-hrs. at city rates (derived from Table 3)	$37.12	$37.12
(3) Average investment in distribution system necessary to deliver 384 kw-hrs. per year	74.24a	476.00b
(4) Loss in delivering 384 kw-hrs. to customer per year in kw-hrs.	96c	492d
ANNUAL COSTS.		
(1) Return at 8% per annum	$ 5.94	$ 0.00
(2) Depreciation at 4% per annum	2.97	19.04
(3) Taxes at 1.5% per annum	1.11	7.14
(4) Distribution loss at $0.015 per kw-hr. (Based on unusually low cost of power production)	1.44	7.38
(5) Excess maintenance hazard and excess operating expenses 4.5% of investment	....	21.42
(6) Total	$11.46	$54.98
(7) Excess cost of serving rural business per year		43.52
(8) Excess cost of serving rural business per month		3.62

(a) An analysis made of certain Wisconsin cities indicates that investment in distribution system for small customers is about twice the annual revenue.

(b) This is an actual weighted average figure obtained from data in Table 3.

(c) Based on an efficiency of 80% in distribution, which is a fair average for city conditions.

(d) These are measured losses and are higher than the calculated losses, and this accounts for rural charge in this table being slightly greater than the rural charge in Tables 3 and 7.

TABLE 7.—CALCULATION OF RURAL CHARGE FOR SYSTEM MADE UP OF EXTENSIONS NOS. 1 TO 7 INCLUSIVE.

Cost of line	$76,684
Number of customers	161
Length of line, miles	62.5
Revenue at city rates	$5,976
*Core loss per annum in kw-hrs.	42,343

Calculation of Rural Charge according to rule 6, employing above totals:

10% of construction cost ($76,684)	$7,668.40
42,343 kw-hrs. at $0.015 per kw-hr.	635.14
Total	$8,303.54
Less 27% of annual revenue at city rates ($5,976).	1,613.52
Annual rule charge for extension	$6,690.02
Monthly rural charge for extension	557.50
Average monthly rural charge per customer (161 customers)	3.44

*Calculated from Table 5, assuming 161 transformers rated at 2 kw. each.

Experience has shown that it is of vital importance that the entire proposition should be definitely understood between the parties and must be included in a formal contract. The committee recommends a form which must have the rules and rates printed on the back thereof.

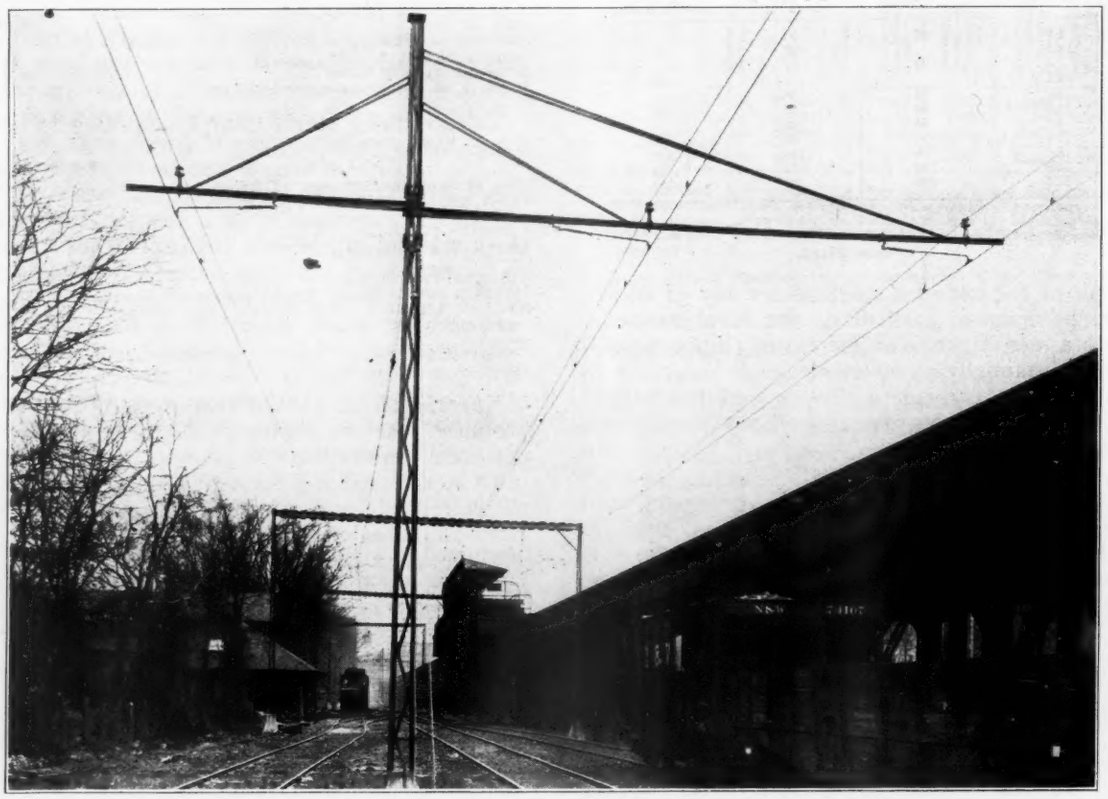
Although a large number of rural extensions have been made in the last two or three years we feel that this development has only begun. In the interest of both the customer and the utility the business should be developed on a sound basis both financially and physically. The committee's effort in the 1920 report and in this report has been toward developing a sound financial basis for these extensions.

UTILITY COMMISSION FUNCTIONS AGAIN IN NEW JERSEY.

Following the nominations of former Judge John J. Treacy, Jersey City, and County Judge Harry V. Osborne, Essex county, by Governor Edwards as members of the Board of Public Utility Commissioners, the Senate has ratified the nominations and a utility board is again operative. The third member of the board is Harry Bacharach, Atlantic City, whose appointment was approved about a week ago. Mr. Bacharach is appointed for 2 yrs., Mr. Osborne for 4 yrs., and Mr. Treacy for 6 yrs. Each receives a salary of $12,000 a year. Mr. Treacy served as a member of the board under Governor Edge, 1914-1917. He has been selected as chairman of the new body. Senator Thomas Brown, Perth Amboy, has been selected as counsel for the board.

TWENTY PER CENT LIGHTING BILL PENALTY EXORBITANT.

The Public Service Commission of Pennsylvania has handed down a decision in a case against the Newmanstown Electric Light & Power Co., Lebanon, holding that a 20% penalty for failure to pay bills for electric service in 10 days, as provided by rules of the company, is "both unreasonable and exorbitant and is out of line with the usual and ordinary penalty imposed by utilities for that purpose." In ordering the company to amend its rules in this respect, the Commission says: "There is no occasion to impose an exorbitant penalty to enforce prompt payment of a bill, since a public utility has within its power the right to discontinue the service for non-payment of bills."



Typical Illustrations Showing Use of Bates Expanded Steel Poles in Electric Railway Construction Work.

Maintenance of Service on Long Power Lines

Fourteenth of a Series of Articles Giving a Concise Review of Electric Power Situation — Duplicate Transmission Systems Sometimes Justified—Protection of Circuits—Reactance Coils

By ALFRED STILL

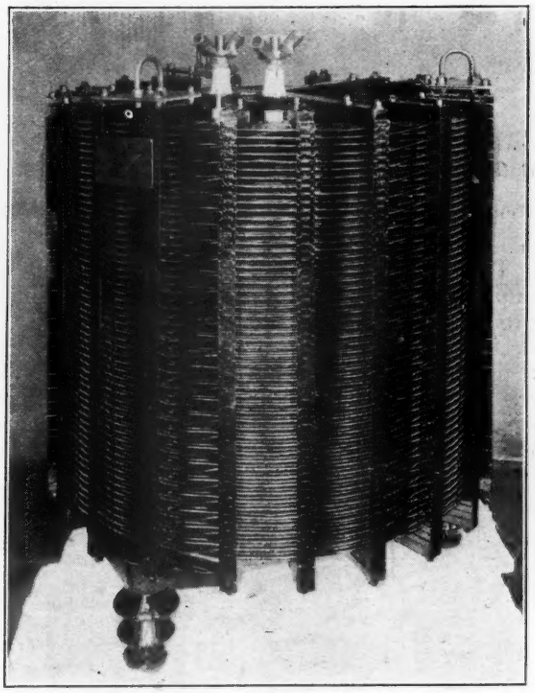
Notwithstanding the care that is now taken in the design and construction of every detail on important power-distribution systems, the line itself would still appear to be the weakest link in an undertaking involving long-distance transmission.

Electrical troubles may be due to faulty insulation, or they may have their origin in lightning or switching operations causing high-frequency oscillations and abnormally high voltages, leading to fracture of insulators or breakdown of machinery. Troubles are more likely to be due to mechanical defects, or mechanical injuries sometimes difficult to foresee and guard against. Trees may fall across the line, landslides may occur and overturn supports, or severe floods may wash away pole foundations; and against such possibilities the engineer must, by the exercise of judgment and foresight, endeavor to protect his work. The width of the right of way should depend upon the height of trees, and should be so wide that the tallest tree cannot fall across the wires; poles and towers should, if possible, be kept away from the sides of steep hills where the nature of the ground suggests the possibility of falling stones or of landslides, and the possibilities resulting from floods must be reckoned with. Other causes of mechanical failure are storms of exceptional violence, either with or without a heavy coating of ice on the conductors. When strong winds blow across ice-coated wires the danger is not only that the wires themselves may break, but also that the resulting horizontal loading on the poles or towers may be great enough to break or overturn them.

Faulty mechanical design of the line as a whole, and improper supervision or inspection during construction, will account for many preventable interruptions to service, but even with the best and most substantial construction there is always the possibility of trouble arising at some place on a transmission line of considerable length.

Advantages of Providing Duplicate Transmission Lines.

If it is allowed that the least reliable part of a transmission system is the line itself it is certainly advisable when circumstances permit to duplicate the lines, the two sets of conductors being connected in parallel, if desirable, under normal conditions. The best protection against interruption would be afforded by carrying the two sets of conductors on separate poles, preferably by different routes; but this would almost double the cost of the line, and it is usual to carry duplicate lines either on one set of poles or on two sets of poles erected side by side on the same right of way. As an alternative to the duplication of the lines the provision of reserve generating plant at the receiving end may be considered, and a comparison should be made between the relative advantages and costs of the various alternatives.



Single-Phase, 282-Kv-a., 25-Cycle Current-Limiting Reactance.

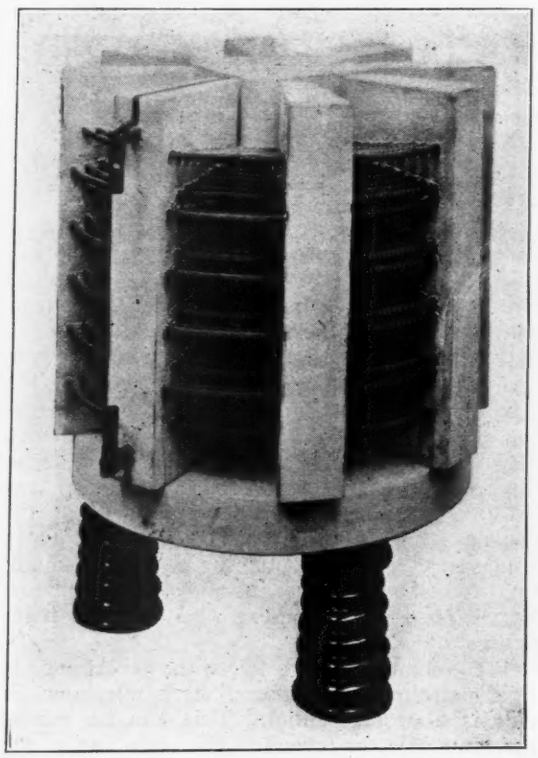
When two parallel lines are run all the way between generating and receiving stations it is usual to provide section switches and by-pass connections about every 20 mi. at the points where patrolmen are stationed. Even if the line is not duplicated it is usually wise on important systems to have patrolmen's houses every 15 or 20 mi., depending on the character of the country. Emergency houses, containing tools and sundry line materials such as wire and spare insulators, should be provided midway between the patrol houses.

For communication between the generating station, patrolmen and substations a telephone circuit is almost essential. This can be run on the same poles or towers as the high-tension conductors, but, if possible, it should be run on separate poles. The extra cost of a separate pole

line for telephone wires is, however, frequently the reason for these wires being supportd on the same poles as the transmission wires. This leads to trouble in the case of a ground on the high-tension wires and, indeed, almost invariably when there is a fault on the power system, except of course, when the power service is entirely interrupted. Even when carried on a separate pole line the telephone circuit is liable to be useless at times when it is most needed. For this reason it is not unusual, on important lines, to provide telegraphic instruments in addition to the telephones, with men that are telegraph operators at the ends of the line and also at any intermediate points where switching stations may be provided. Quite recently experiments have been made with wireless telephony between generating and substations or intermediate points on the line, and this system of communication appears to have some advantages over the telephone with metallic circuit. The radio-telephone set required would be similar to the type developed during the war for service in the field. This should be supplementary to, and not in place of, the usual private telephone system with metallic circuit. It should prove to be valuable in emergencies for communicating with repair gangs or in case regular communication be interrupted.

Investment Considerations Involved in Building Duplicate Lines.

The question whether or not lines shall be duplicated must be decided mainly on economic grounds. Obviously the capital investment is necessarily greater for a duplicate line than for a single line, but economic considerations involve the cost of possibly interrupted or unsatisfactory service which may sometimes greatly outbalance the increase in first cost. The magnitude and importance of the undertaking are important factors in the problem.



68-Kv-a. Reactance Coil With Protective Resistance in the Center.

Another point to bear in mind is that the purely engineering difficulties may become very serious if an attempt is made to transmit very large amounts of power on a single set of conductors. It is not possible to lay down definite rules as to the practical limit for a single line; this will depend on the distance and voltage, and therefore on the current to be carried per conductor. But if the power to be transmitted exceeds 30,000 kw. it would generally be wise to duplicate the conductors, even if carried on the same set of supporting towers; and if the total power exceeds 60,000 kw. two separate tower lines, either on the same right-of-way or preferably following different routes, will in most cases lead to ultimate economy.

When the system embodies a number of substations and two or more generating stations the best arrangement of transmission lines including tie lines between substations is a matter deserving the closest study. The arrangement should always be planned so that the failure of any section of the transmission system will not lead to complete interruption of service in any of the areas served by the substations. The chief difficulty in solving problems of this nature lies in estimating the probable load to be delivered to the various centers of demand.

In America it is not uncommon to transmit energy along duplicate lines with substations in tandem and half of the machinery in each substation connected to each of the incoming lines. These radial transmission lines are protected by overload circuit-breakers with time-limit settings so adjusted that only that part of the transmission line which is beyond the fault will be disconnected.

Automatic Protection of Transmission Lines.

In Europe, and especially in England, what is known as the ring system has been used with success. It has the advantage that the load is normally supplied with energy from both ends of the line, no spare or idle feeders being provided, but in the case of a fault causing a break in the line the load may be supplied from the end which is still connected to the source of supply until the fault had been repaired.

It is not a very easy matter to design selective relays on an alternating-current system which shall operate only to disconnect a faulty section of line. Yet when lines are operating in parallel to feed the same load it is necessary to install such relays because, otherwise, a fault on either of two lines in parallel will draw energy from the busbars even after the overload circuit-breaker at the power station has disconnected one of the feeders. The principle of the Merz-Price method of protecting a section of feeder fed from both ends is illustrated in the accompanying diagram. The secondaries of the current transformers are so connected through pilot wires running alongside the feeder that, under normal conditions of working, i. e., with energy flowing along the power line in one direction only, there will be no current through either of the relay coils. On the occurrence of a short-circuit within the section between the two current transformers

energy flows from both directions and sets up a current in the secondary circuit through the pilot wires, thus causing both relays to operate and disconnect the faulty section of the line.

The chief objection to this and similar protective systems is the necessity for pilot wires. It must be admitted that this is a very serious objection which has undoubtedly stood in the way of this method of protection being adopted on a large scale. Many engineers object to the use of any relay device involving somewhat fine setting of armatures or tripping mechanism liable to disconnect main switches at times when such disconnection may not be necessary. This is an objection which may be applied to nearly all so-called automatic safety devices, and it is unquestionably true that if it is possible to maintain efficient service without such devices they should not be installed. On the other hand, the importance of reliability in all automatic protective devices is so well recognized that there are very few on the market at present which may not be relied upon to give good service.

Efforts are being made to devise reliable and inexpensive protective systems without using the objectionable pilot wires, and these are meeting with some measure of success. The split-conductor cable, as sometimes used for underground power transmission and distribution, is an example of what has been done in this direction. By making each conductor of an underground cable in two sections insulated from each other, but normally connected in parallel at the two ends, the current will divide itself according to the impedance of each section. Relays are provided which will not operate under this condition, but will trip the main circuit-breakers in the event of this condition being upset, which will usually be the case in the event of a fault developing in the cable itself.

Use of Current-Limiting Reactors for System Protection.

Before considering the important subject of lightning protection the present trend in the use of power-limiting reactors will be briefly discussed. The necessity for providing inductive reactance in alternating-current systems, to limit the current in the event of short-circuits, arose only when the rapid development of the electric power industry led to the construction of very large generating units and more complicated systems of transmission and distribution. The concentration of enormous amounts of energy at one point of such a system means that a dead short-circuit may cause the destruction of plant or cables. Even if automatic circuit-breakers should succeed in clearing the fault, the damage may be done before they have time to operate.

In the case of electric generators, such as the large 35,000-kw. turbo-alternators, now frequently installed in steam-electric power stations, a short-circuit near the machine results in an enormously increased current at the instant the short-circuit occurs. The mechanical forces exerted on conductors, including the windings of the machine itself, are approximately proportional to the square of the current. If, therefore, the instantaneous short-circuit current is 31 times the normal full-load current, the mechanical forces to which the armature conductors will be subjected will be about 1000 times as great as under normal working conditions. It is not an easy matter to construct an insulated winding to withstand these forces without displacement or injury to the insulation.

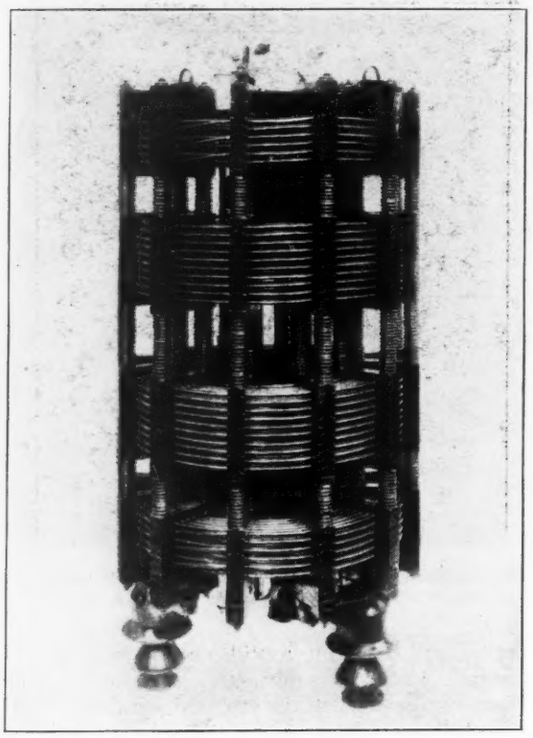
Feeder Choke Coils in Compartments at Brunots Island Station of Duquesne Light Co.

The instantaneous short-circuit current is limited only by the impedance of the circuit and not by the armature reaction which, however, will reduce this current to about one-sixth or one-eighth of the instantaneous value in a very short time—perhaps less than a second—but only after the damage may have been done. Modern generators are purposely designed with large impedance, but, nevertheless, some external reactance is frequently found to be necessary as a protection against destructive short-circuit currents. If the internal selfinductive reactance of a large generator is less than about 12% it is advisable to provide an external reactance.

Power-limiting reactors are now used on large systems for other purposes than the protection of individual generators. It is common practice to install them between sections of the busbars in order to limit the flow of current from one section to the other when trouble occurs. This prevents the feeding of large amounts of energy from a set of generators connected to one section of the busbars into a fault in or near another section of the busbars. For the same reason reactors are installed in the tie connections between two generating stations on the same system. It is not customary or advisable to concentrate more than 60,000 or 70,000 kw. on one section of busbars without providing busbar reactors to limit the amount of energy that can flow from one section to the other. Normally there is not much flow of energy along busbars, since the feeders and generators are so connected that only small out-of-balance currents will exist in them. For this reason it is possible to use much larger per-

centage reactances between busbar sections than between the generators and busbars.

Another part of the system where power-limiting reactances are useful is in the feeders themselves, near the point where they connect on to the busbars. A short-circuit on a feeder, occur-



Current-Limiting Coil Rated at 119 Kv-a., 198 Volts and 200 Amperes for 3-Phase, 60-Cycle Service.

ring not very far from the generating station, may result in a shut-down of the station unless reactors are provided to limit the current. The trouble is brought about not only because a large current is drawn from the generator, but because a short-circuit on or near the busbars reduces the voltage to zero, and may lead to synchronous machinery falling out of step. By introducing reactance between the fault and the busbar synchronous apparatus will not be seriously affected so far as parallel operation is concerned, because the busbar voltage will not fall to zero.

While it thus appears that power-limiting reactors fulfill a very desirable and, indeed, necessary function, the problems involving the amount of reactance in each unit installed, and the best location for these reactors, are not easily solved; every system must be studied in detail and careful calculations made in order to determine what is best in the matter of protection by external reactances. Factors entering into the problem include cost, loss of voltage, loss of energy, and reduced power-factor.

Factors in Construction of Power-Limiting Reactors.

In 60-cycle systems the current is usually a lagging one, and the power-factor is none too high so that further reduction by introducing reactors of too high a reactance is very undesirable. In 25-cycle systems the load usually consists of synchronous machinery, and the power-factor can be adjusted by controlling the exciting current of the machinery on the circuit. These and similar considerations must, however, be taken account of in planning the protection of the system as a whole by means of power-limiting reactors.

Instances have occurred of reactors failing at times when they were most needed to protect the system. Such failures have, however, always resulted in improvements in design and methods of construction, so that future trouble is not likely to be due to defects in this particular type of protective apparatus.

The latest design of reactor, as constructed by the Westinghouse Electric & Manufacturing Co., is built up of flat coils of finely stranded bare copper cable placed in horizontal layers between substantial cleats of insulating and heat-resisting material. The stack of coils as firmly clamped together by means of treated hickory rods, and the complete reactor is mounted on substantial insulators.

The General Electric Co. has a design of power-limiting reactor in which the bare copper winding is securely held in place by pillars or blocks of concrete which are cast around it, with spaces of bare wire between the concrete supports. In all designs it is customary to increase the spacing between two or three of the finishing turns at each end of the reactance coil to resist the higher voltages which are to be expected on these end turns at times when disturbances occur.

The latest development in the reactors built by the General Electrical Co. has a concrete central core containing a resistance connected as a shunt to the reactance. It is claimed that this resistance absorbs the energy of high-frequency oscillations and prevents the building up of high resonant voltages across the reactor itself and other inductive apparatus connected to the system. The energy loss in the resistance under normal working conditions does not appreciably affect the efficiency of the power plant.

Grounding the Neutral of Three-Phase Systems.

The chief arguments in favor of grounding the neutral are (1) that the difference of potential between any conductor and the supporting structure or earth remains unaltered, and cannot become excessive in the event of the grounding of a high-tension conductor, and (2) that it is possible to detect instantly, and disconnect by automatic devices or otherwise, any portion of the system that may become accidentally grounded. The chief objection is that under such conditions the grounding of any one conductor causes a short-circuit, and, even if disconnected by the opening

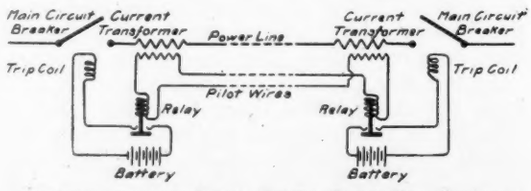


Diagram of Merz-Price Feeder-Protection System.

of a switch, leads to an interruption of supply. By inserting a resistance between the neutral and the ground connection the current through the fault can be limited to just so large an amount as may be necessary to operate an automatic de-

vice, or give an indication that there is a fault on the line. Instead of opening the switches and disconnecting the line, the ground connection to neutral may be opened, thus leaving the neutral ungrounded until such time as it is convenient to carry out repairs; but this would be equivalent to running normally without a grounded neutral. The chief advantage of transmitting with ungrounded neutral is that the grounding of one conductor only does not lead to an immediate interruption of service. The chief disadvantage is probably the fact that the potential between earth and the other conductors is immediately raised, being $\sqrt{3}$ times greater in the case of a 3-phase transmission system than under normal conditions when the voltages are balanced.

By grounding the neutral of a high-tension system the insulation is protected from abnormally high pressures which might aggravate the trouble in the event of a ground occurring on one wire. Whether or not the neutral is to be grounded resolves itself into the question of line insulation considered in connection with continuity of service.

Not many years ago the tendency in this matter was toward providing substantial insulation throughout the system and omitting the grounding of the neutral, but at the present day many engineers are grounding the neutral, either solidly or through a resistance. If a resistance is used its proper value must be carefully determined. The neutral of only one generator should be grounded in order to avoid possible cross currents between generators operating in parallel.

The modern practice of carrying out repairs and replacements on live overhead systems, and the means adopted for the protection of overhead lines from lightning and abnormal pressure rises, will be taken up in another article.

CONSTRUCTION OF CONDUIT TUNNELS UNDER BODIES OF WATER.

Borings Indicate Soil Conditions and Show Best Level to Use—Points to Consider in Carrying on the Work.

In many cities it is necessary to build tunnels for conduit and cables under rivers or other bodies of water which may separate power plants from the distribution areas. Armored submarine cables imbedded in the bottom of rivers have been used to some extent in the past, but trouble of various kinds, and the dredging up of cables, have shown that it is more economical in the end to build tunnels, especially where many cables are to be installed.

In general, unless work of a similar nature has been done in the vicinity of a proposed tunnel, it is best to have test borings made at the location of each shaft to ascertain the kind of material and the depth of rock. These borings can generally be made at a relatively low cost per foot, and where carefully made are valuable in locating the depth of the best material in which to build the tunnel. If a stratum of stiff blue clay is found of sufficient depth to permit the tunnel to be built and leave from 12 to 15 ft. of good material between the roof and the river bed, the tunnel can be constructed more economically than to drive it through rock. Where it is necessary to build in rock it has been found that much trouble results from water, both during construction and later. Water follows the fissures or faults in the rock and, under pressure resulting from an 80 to 90-ft. head, it is difficult to handle and often results in a wet tunnel after the work is finished. A depth of 50 to 60 ft. below water level for the top of the tunnel is desirable in order to avoid foundation piles for bridges, etc.

In excavating the shafts, steel rings of 0.75-in. by 4-in. stock are used to hold lagging in place, which is usually matched white pine 2 by 6-in., 4 ft. long, each set being put in place after 4 ft. is excavated until the required depth is reached. In cases where quicksand is encountered it is often necessary to use steel shields or cylinders which can be sunk by the application of sufficient weight on top. In swelling clay or other unstable material where the ordinary method of using steel rings is impracticable it is necessary to timber the shaft until good ground is reached. A square shaft with 12 by 12-in. timbers, well braced and backed up by 2-in. sheeting, will be found best for these cases.

When rings are used wooden drums approximately 1 ft. smaller than the excavation are placed inside and the annular space is filled with concrete. Four feet is a convenient height for the drums, the concrete being well tamped every 8 to 10 ins. A mixture of one part of portland cement, three parts torpedo sand and five parts crushed limestone is a good proportion for the concrete. Material should be furnished according to approved specifications and should be tested as a check, especially the cement.

Procedure Required in Excavating Tunnel Sections.

Excavating and concreting the tunnel are usually done by using wooden forms of the section desired, set about 12 ft. apart, a space for the concrete being left between the lagging and the clay or rock as in building the shafts. In some cases it is advantageous to use steel forms, such as bent channel iron, leaving more working room in the drift. Small cars on a narrow railroad are used for conveying the excavated material to the shaft, when it can then be raised in a bucket or an elevator. The same railroad may be used to carry the concrete to the heading. The lines and levels, especially where curves are necessary, should be given for each form. Small lines may be swung on each side of the shaft, a transit instrument being set on line below, and the proper angles turned. A line of levels is transferred from above and stakes set every 10 to 12 ft.

When the tunnel and shafts are concreted they should be plastered with portland-cement mortar mixed one part of cement and one part of fine sand or powdered stone. Small leaks may be stopped by adding soda ash to the mortar. Leaks which cannot be stopped by plastering are trained to one point where a small pipe is inserted, and after the plastering is finished the pipe is plugged.

In many cases 3-in. galvanized angle-irons are placed 4 ft. apart vertically and about 2 ft. from each side of the shafts, making two segmental spaces which are filled with ducts. As many ducts as are necessary can be built in the tunnel, and the number added to as needed, up to the capacity of the space available. Vaults at the top of shafts

should be larger than ordinary to facilitate the handling of a large number of cables. A 6-ft. tunnel, for example, should have manholes at the top of shafts about 15 by 15 ft. in size. Smaller and less expensive tunnels are sometimes built under land where permission is not easily obtainable or where it is not practical to make open cuts.

CHINA AS FIELD FOR ELECTRICAL DEVELOPMENT.

Opportunities for American Construction Engineers and Contractors—Great Natural Resources Available for Use.

An important article in the *Revue Generale de l'Electricite*, of Paris, considers the possibilities of China from the French viewpoint and although France has not been and is not likely for some time to be a serious competitor of other nations in this particular country, it is important that we should realize the fact that China offers great possibilities for American construction engineers and contractors as well as manufacturers of electrical machinery and appliances, and that other nations are preparing for the time when activities in the electrical field will be very considerably greater than they have been during the past few years.

Here is a country of 400,000,000 people of which, it is true, 99% still live in the manner of their ancestors of 2000 years ago, but with rapidly changing ideals and a minority of enlightened highly educated men becoming every day more thoroughly imbued with Western ideas the engineer is likely to find ample opportunities in the near future. Professor Middleton Smith, who has spent many years of his life in China and has travelled the country in every direction, has pointed out that the Chinese have an extraordinary faculty for assimilating new ideas and of appreciating the value of desirable innovations once their meaning and advantages are made clear to them. They are greatly interested in the many applications of electricity leading to increased comfort and economy. They welcome its use for purposes of ventilation, heating, cooking and lighting. Summing up his views on the possibilities of China as a field for modern Western development, Professor Smith says that "if Spain is the land of tomorrow, China is the land of next week."

The enlightened Chinese are very quick to pick up the trend of new ideas and understand the essentials of methods and of things which at first sight must seem to them incomprehensible. Apart from the work done by the United States along educational lines, other countries—notably England—have established schools from which engineers and artisans of no mean caliber are turned out annually.

During the years immediately preceding the war Germany had a powerful hold on the ports and larger towns and was a serious competitor with America and European nations. At the present time she is making determined efforts to recover lost ground. Japan has held her own and is probably the most serious trade competitor of other nations in China today. A recent article in the London *Times* contained the statement that the competition of Japan is mainly in the smaller articles and accessories, and that in the heavier machinery both England and America are making good progress.

In 1914 four cities had electrically operated street cars; they were Hongkong, Shanghai, Tientsin and Mukden in Manchuria. The most important city from the standpoint of electrical development is Shanghai, where the total consumption of energy in 1914 was 32,885,000 kw-hrs. It is the center of keen commercial rivalry between foreign nations, and progress in electrification and lighting extensions are shown by the fact that the above-mentioned figure for the annual energy consumption in 1914 grew to 50,000,000 in 1915, and the growth continues at about the same rate.

That there are enormous possibilities of development is well illustrated by the fact that in 1916 the capacity of the electric generating stations for the whole of China did not exceed 33,000 hp.

Statistics of importations show that in 1911-1912 the city of Shanghai imported from Japan 2.5 times as much, from England 3 times as much and from Germany 6 times as much as from the United States. In the year 1914 the importations for the industrial and mining center of Fou-Tchow were about of equal value from Great Britain and Germany, each of these countries supplying about five times as great a value of merchandise as was imported from the United States. The war has, of course, greatly modified the relative positions of the various countries. Both Japan and the United States not only held but improved their position during the period when competing nations were seriously crippled by the war. In this connection the accompanying relative figures, as published by the *Electrical Review* (London), should be of interest. They refer to importations of electrical materials and machinery for the whole of China for three consecutive years.

TABLE SHOWING RELATIVE IMPORTS INTO CHINA FROM VARIOUS OTHER COUNTRIES.

	1915	1916	1917
Japan	845	1700	2564
United States	315	614	910
Great Britain	404	710	380
Other countries	290	200	145

Water power is available in certain parts of China. A project is on foot to develop the rapids of the Yang-Tse river and erect a huge powerhouse at Tse-Chuang. It is estimated that the horsepower available exceeds that of Niagara Falls. At the present time the companies actually established and operating in China are mainly Japanese, British and Chinese. American enterprise has been to a certain extent paralyzed by legislative restrictions and a certain difficulty or reluctance in conforming to the somewhat exacting requirements of Chinese procedure. If America is not so active in the electrical field in China as some of her competitors the fault is not entirely that of the engineer or the man of business. There appears to be some reluctance on the part of our own Congress to remove certain obstacles to the establishment of American companies in the larger cities such as Shanghai, barriers which other nations have apparently overcome to their advantage.

Electrical Construction Features of Raisin Plant

Elevators, Conveyors and Process Machinery Driven by Belted and Geared Motors—Dead-Front Switches Used for Lighting and Motor-Circuit Control—Motor Load of 1485 hp. in Single Plant

By W. A. SCOTT

The great raisin-growing region of California in the vicinity of Fresno occupies a central location in the San Joaquin valley. This valley has a length of over 300 mi. extending from Stockton to Bakersfield. In width it extends from the Sierra Nevada mountains on the east to the Coast range on the west, the distance across the valley at Fresno being close to 80 mi.

The 1920 production of raisins has a value estimated at $50,000,000. The development of this industry, requiring the construction and equipment of treatment and packing plants, has involved the expenditure of millions of dollars. The California Associated Raisin Co. has about 9000 raisin growers as shareholders, and operates 30 plants equipped for putting their product in condition for the market. The operation of these plants requires hundreds of electric motors, and makes up one of the heaviest power loads on the lines of the San Joaquin Light & Power Co.

The largest of the associated company's plants, and the one most recently completed, is situated on the outskirts of Fresno, and is locally known as the "Sun-Maid City" plant. Here, on a 20-acre tract, is a group of three buildings—the powerhouse, stemming and drying building, and the seeding and packing house.

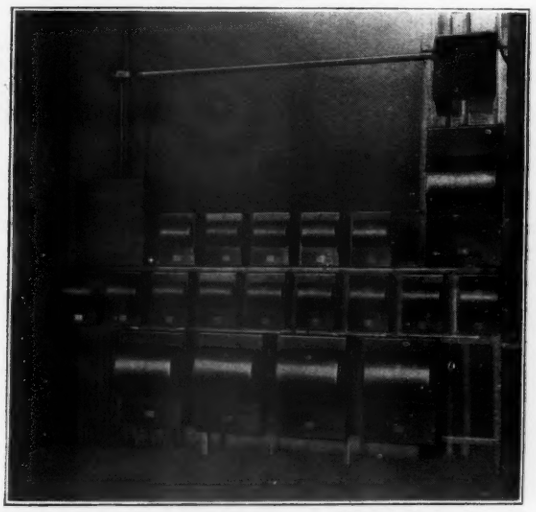
Large Motor Load Supplied by Single Plant.

In this entire plant there is a connected motor load of 1485 hp. However, steam-engine drive is utilized for some operations, and quite extensive use of steam is required for air-heating, in connection with driers, and for many cleaning processes. The steam is produced by one Stirling and two Badenhausen boilers of a combined capacity of 960 hp. These are oil fired, requiring 100 bbls. of fuel oil per day when operating at full capacity. They are equipped with B. F. Sturtevant economizers, Venturi water meters, Worthington oil meters, and Foxboro CO_2 recorders. Water for all purposes is taken from a 750-ft. well, the pumping plant consisting of two 250-g. p. m. motor-driven centrifugal pumps that lift the water to a height of 150 ft. to a water tank from which water for general plant purposes is supplied. A Worthington pump driven by a 100-hp. motor is provided to supply water for fire protection.

Transformers Installed to Reduce Supply Voltage.

The Associated Raisin Co. purchases electric power from the San Joaquin Light & Power Co., the latter delivering energy at 10,000 volts to the raisin company's transformers installed on the mezzanine floor of the powerhouse. Three oil-cooled Maloney transformers, having a combined capacity of 1000 kw., reduce the incoming voltage to 440 volts for distribution to the motors. Lighting transformers of 100 kw. capacity, and a 440/220-volt set for machine-shop and planing-mill motors are also provided.

Electric power at 440 volts is delivered to the distribution centers in the two plant buildings from a secondary switchboard situated on the transformer floor. The nine power circuits controlled here are conducted in metal conduits through tunnels to junction boxes on the several floors of the two main buildings. One under-



Switchboard for Control of Motor and Lighting Circuits.

ground tunnel leading directly to the seeding and packing house is 60 ft. long; the other, which makes a right-angled turn in its course to the treatment plant, is about 200 ft. in length. Light and telephone lines as well as power circuits are conducted through these tunnels. From junction boxes on each floor of the two buildings the energy for the motors is distributed to switching centers, which in the drier plant are provided with dead-front Square-D switching equipment.

Each Motor Controlled by Dead-Front Switching Equipment.

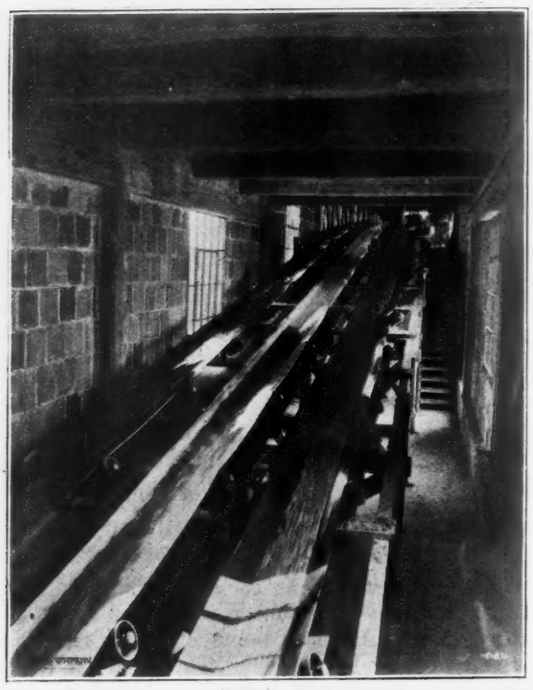
In these installations each switching unit, by which an individual motor is controlled, is inclosed in a metal box, being operated from the outside of the box by means of a handle and having no live conductors exposed. As a means of securing safety while an employe may be making

repairs, a motor can be locked out of circuit at the switch. The operator at any motor-driven machine may stop the motor by pushing a button. In case an additional motor has to be installed this may be arranged for by extending the board and adding a switching unit; and other units may in like manner be added when required. These dead-front installations, in addition to being economical to install, fully meet the requirements of the Board of Underwriters and the California Safety Commission. Square-D panels installed on the several floors of the stemmer and drier building carry about 200 units of the 3-pole type, ranging in capacities from 30 to 400 amperes.

A total of 254 motors are in use around the plant, these being of Westinghouse, Robbins & Myers, and General Electric make. Westinghouse starters are used in connection with the larger motors, and FP10 General Electric switches are used on motors of 5-hp. capacity and less. Motor speeds range from 670 to 1800 r.p.m., leather belts being used in most cases, but the numerous belt conveyors and the seeders are gear-connected to the motors. There are 24 motors of 0.05-hp. each in the packing department, operating at 110 volts on Bond automatic weighing machines. Capacities of the larger motors range from 2 to 100 hp. About 60% of the motor power of the entire plant is used in connection with the preparatory processes in the drier building. Such processes consist of cleaning, stemming, grading and drying.

Motor-Driven Dust Collector Employed to Remove Soil.

Raisins are delivered to the plant by the producers in 150-lb. boxes, which pass by conveyors to stemmers. These are machines with vibrating aprons and revolving blades, driven by belt by a 15-hp. motor for each machine. The soil that comes in with the raisins is taken up by a motor-driven dust collector at the top of the stemmer. The stemming process is followed by steam cleaning under pressure, and grading. The grading machines are made up of vibrating screens, each one of which has apertures differing in size from those of the other screens.



Motor-Driven Belt Conveyor Operating Between Drier and Seeder Buildings.

The cleaned and graded raisins are carried to the top floor by bucket elevators feeding into the driers. There are 10 driers, each equipped with a system of mechanical drapers, arranged in series, one above another.

Motor-Driven Fans Supply Heated Air to Driers.

At the base of each chamber is a set of steam coils by which air is heated to 160 deg. F. The coils are placed at the inlet of a circulating fan by which hot air is forced through ducts throughout the drying chamber, bringing it in contact with the raisins as they pass downward from one draper to another. Of the 10 fans for the driers, eight are electrically operated, the other two being steam operated. In cases of the former, each drier unit is equipped with a Sturtevant No. 15 multivane hot-air fan, driven at a speed of 175 r.p.m. by a 40-hp. motor. An accompanying illustration shows a view of the pulley and motor of one hot-air unit. On the right in the same illustration are shown the Sturtevant multivane cold-air fans, each of which is steam-operated by a Sturtevant engine. In the successive heating and cooling processes the short cap stems that still adhere to the raisins are loosened and readily taken out by the cap stemmers.

Nails or other pieces of iron that may find their way into the mass of raisins are picked up in transit over the conveyors by magnetized pulleys which are excited from a small motor-generator set supplying direct current for this service. The conveyors carrying muscat raisins discharge in the second building into hoppers from which they are conveyed to 12 seeders. Two additional seeders are fed direct from the hoppers. The seeders, situated on the third floor, are so equipped that the raisins pass by gravity between rubber rolls and a saw-like cylinder by which the seeds are extracted. Preparatory to the seeding process the raisins are passed through a perforated revolving cylinder in which they come in contact with steam by which they are softened. A 7.5-hp. motor, geared to the seeder mechanism, supplies the requisite power to each machine.

The seeded fruit is then delivered through spouts to the packing and weighing floor where it is packed in cartons, the latter being packed in boxes on which lids are automatically nailed. All handling is by conveyors, whereby the boxed raisins are delivered either to storage or to the shipping platforms.

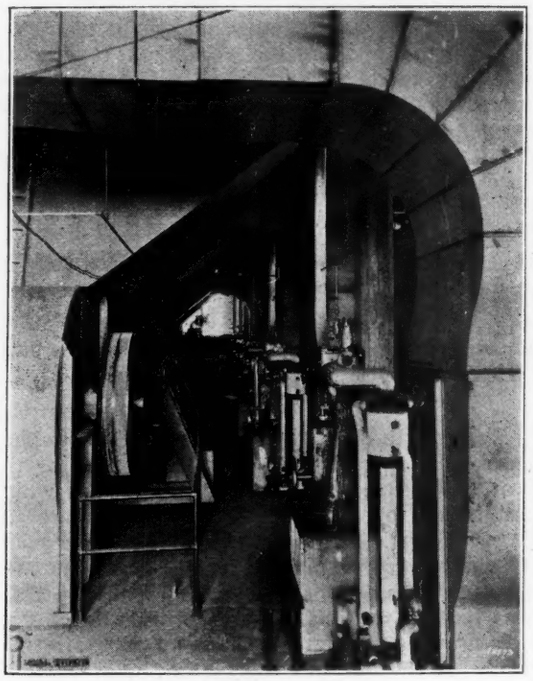
Every phase of mechanical process in the entire plant is subject to electric drive except the limited features of steam operation already referred to. In this plant the power consumption during the past season, which ran from October to December inclusive, amount to 542,200 kw-hrs., and the season's power consumption at all the associated company's plants amounted to 929,167 kw-hrs.

The plant and arrangement of equipment above described was designed by Hunter & Hudson, San Francisco, consulting engineers, and the in-

stallations were made under their supervision. The Valley Electrical Supply Co., Fresno, carried through the electrical construction and installations under contract.

ELECTRICAL FEATURES OF PLANTS ASSOCIATED WITH RAISIN INDUSTRY.

Seeds extracted from the muscat raisins in the plants of the Associated Raisin Co. of Fresno are taken over by the California Products Co., which has a palnt of considerable magnitude in that city. One phase of its operations is to subject the seeds to processes of cleaning, grinding and hydraulic pressure, whereby a valuable vegetable oil is extracted. It is claimed that 5% of the seed, by weight, is oil. In this plant many tons of raisin seeds are stored, ready for the processes mentioned. All equipment, except the presses, is electrically operated. The first unit of equipment is a 30-hp. Allis-Chalmers motor connected by Morse silent-chain drive to a high-speed fan that serves as a seed cleaner. After being cleaned, the seeds are pulverized in motor-driven grinders and the resultant pulp is conveyed to hydraulic presses, the several operations requiring a system of electrically operated belt conveyors.



Motor-Driven Hot-Air Blowers at Left—Engine-Driven Cold-Air Blower at Right.

Another and more extensive branch of the California Products Co.'s industry here is the ginning of raw cotton and the working up of cotton seeds. The raw cotton is carried to the gins by the action of a system of motor-operated suction fans. Each gin is operated by a 50-hp. motor; and the ginned cotton is carried to bale presses by a motor-driven blower.

The equipment used for treating the cotton seeds consists of linters and hullers, which are subject to motor drive. The linters remove the fine particles of cotton that have adhered to the seed, and the hullers are a combination of cutters and grinders. There are two batteries of six linters each, arranged for group drive by one 100-hp. motor for each battery. In the next process a 100-hp. Allis-Chalmers motor drives two hullers and a separator and cleaner, all machines being belt-connected to motor pulleys by Morse chain belts.

For all these processes pertaining to raisin seeds and cotton products, there are 16 motors with a connected load of 512 hp. Central-station energy is received at 11,000 volts, and is stepped down to 440 volts by three 150-kw. power transformers; there is also one 20-kw., 220/110-volt transformer for lighting. The distribution of energy throughout the premises is made from a switching panel provided with Square-D units of 200, 400 and 800 ampere capacities for motors and 30 amperes for lighting. These units are mounted upon a frame work of metal pipe.

JANUARY EXPORTS OF ELECTRICAL GOODS SHOW INCREASE.

Total Amounts to $15,332,955; Increase of $8,982,634 Compared With Same Month Last Year—Seven Month's Figures Are $70,558,473.

The exports of electrical goods to foreign countries for January were valued at $15,332,955, compared with $6,350,321 for the corresponding month in 1920, or an increase of $8,982,634. For the 7 mo. ending January, 1921, the total exports amounted to $70,558,473, an increase of $23,725,724 over the 1920 figures and an increase of $31,729,108 over the total for the 7 mo. ending January, 1919.

The following classified figures give the detailed data for January, 1921, compared with the corresponding month for the previous year:

Electrical Machinery and Appliances (except locomotives):	Jan., 1920.	Jan., 1921.
Batteries	$ 374,730	$ 655,712
Carbons	139,640	70,823
Dynamos and generators	413,293	629,461
Fans	29,587	358,444
Heating and cooking apparatus	113,819	291,546
Insulated wire and cables	661,842	2,447,654
Interior wiring supplies, including fixtures	168,889	422,015
Lamps—		
Arc	90	1,430
Incandescent—		
Carbon filament	7,133	9,075
Metal filament	211,697	620,434
Magnetos, spark plugs, etc	261,542	303,900
Meters and measuring instruments	188,123	398,878
Motors	735,236	2,064,424
Rheostats and controllers	18,558	161,253
Switches and accessories	294,036	797,246
Telegraph apparatus, including wireless	183,404	99,673
Telephones	230,186	659,373
Transformers	350,364	925,372
All other	1,968,152	4,416,242
Total electrical machinery, etc.	$6,350,321	$15,332,955

"HOME RULE" OF PUBLIC UTILITIES DISCUSSED IN PEORIA.

Various Phases of Regulation Covered in Talk Given Recently Before the Peoria (Ill.) Association of Commerce.

Samuel Insull, president of the Commonwealth Edison Co., which serves Chicago with electricity, criticized efforts to cripple public utilities under the guise of so-called "home rule" in an address before the annual dinner of the Peoria Association of Commerce. After tracing the gradual development of the utility industry from local plants to enterprises serving great areas, he said the in-

dustry had now reached the third stage of development—the status of an interstate industry.

"Illinois is already spanned by a series of interconnected electric transmission lines that extend in all directions beyond the boundaries of the state," Mr. Insull said. "By the construction of a few comparatively short links, these Illinois lines would become part of a transmission system linking Minneapolis and St. Paul on the north, with St. Louis and Louisville on the south and with Cincinnati and Pittsburgh on the east, and thence to the Atlantic seaboard.

"It is only by the development of these statewide and interstate transmission systems that we shall attain the utmost in utilization of electricity in two extreme directions—electrification of the railroads on the one hand and electrification of the farms on the other.

"Already 10,000 farms in Illinois are drawing from cross-country transmission lines the same kind of electric light and power service obtained by city dwellers. With these transmission systems unhampered by parochial regulation, electrification of the railroads east of the Missouri river is only just around the corner.

"By a step backward to local regulation of public utilities, and to consequent obstruction of this development, farm electrification will be checked and railroad electrification indefinitely postponed.

"The natural economic development is encountering its most senseless opposition in the very place where it has been most useful to commerce and industry and organized society. That place is right here in Illinois, the heart of the Mississippi valley 'electric belt,' where public utility service averages higher in efficiency and lower in cost to the user than anywhere else in the world."

WIRELESS FOG SIGNALS FOR NEW YORK HARBOR.

Radio Compass on Ship Gives Exact Bearing in Much the Same Manner as Magnetic Compass, and Without Skilled Operator.

The Secretary of Commerce has announced that in view of the development of a radio compass by the Bureau of Standards three wireless fog signals would be immediately installed at the entrance to New York harbor. Each of these three stations is equipped with an automatic radio set sending out signals continuously during fog or thick weather. They may be picked up on shipboard by means of the new radio compass which indicates the direction from which the radio signals are sent out, and by taking observations on the different stations the captain of a vessel may determine his exact position without being obliged to rely on the former unsatisfactory method of locating himself by the sound of whistles and fog horns.

These signals have been developed as the result of co-operative experiments by the Bureau of Standards and the Lighthouse Service, and more especially through the research work of the Bureau of Standards in improving the radio compass. It differs from all other systems in use for determining radio direction in that the navigator himself can determine radio bearings just as he uses his magnetic compass for bearings in clear weather, and he does not have to depend upon expert radio operators. The other advantage is that the sending apparatus is easily installed and can be operated by the regular light keepers without any skilled personnel, and that any number of vessels at sea, equipped with radio compasses, may obtain their position at the same time without interference.

These signals have been installed on Ambrose Channel and Fire Island lightships and at Sea Girt lighthouse, and will operate on a wave length of 1000 meters, the international standard for such signals. The Lighthouse Service plans to establish other stations near the entrances to the principal ports and at other important points on the Atlantic and Pacific coasts as rapidly as necessary funds are provided. Because of the great risks and uncertainties attendant on the navigation of vessels during fog, it is expected that this development will be of the greatest value in increasing the safety of navigation on the high seas.

MILWAUKEE COMPANY SHOWS GOOD YEAR'S BUSINESS.

Report to Stockholders Indicates Progress and Shows General Trend of Business and Financial Conditions.

The growth of the business of The Milwaukee (Wis.) Electric Railway & Light Co. during the year is reflected in its gross earnings, which amounted to $19,064,335.11, an increase of $4,030,349.35, or 26.81%, according to the report of the North American Co., of which the Milwaukee company is a subsidiary. Railway traffic was heavier than in 1919, as is indicated by increases of 5.67%, 13.34% and 13.86%, respectively, in revenue passengers, car miles operated and car hours. Sales of electric energy amounted to 249,248,313 kw-hrs., 24.11% more than in 1919, while the number of electric customers increased from 72,292 to 83,361, or 15.31%. The demand for heating service also increased, sales of steam aggregating 712,908,414 lbs., an increase of 8.48%.

Construction expenditures during the year amounted to $3,680,761.49, the principal items of which were extensions and additions to transmission and substation equipment incident to the receipt of power from the Wisconsin Electric Power Co., and additions to the electric and railway systems made necessary by the growth of the company's business.

The continued increase in the electric load compelled the company to put into effect in August restrictions on the use of power. To provide the necessary additional power supply, a new generating station, designed for an ultimate capacity of 200,000 kw., was constructed on the shore of Lake Michigan, just south of Milwaukee, and the first unit of 20,000 kw. was placed in operation in December. The second unit of 20,000 kw. will be placed in operation in April, 1921. This plant was built and is owned by the Wisconsin Electric Power Co., a company organized for that purpose and which issued and sold, to finance the construction, $5,000,000 of its 25-year sinking fund gold bonds. The Milwaukee Electric Railway & Light Co. operates the plant under a lease and receives its entire output.

EDITORIAL COMMENT

Farm Line Construction

When one stops to consider the great population living on American farms, who are practically without any form of electrical convenience, it is at once evident that here lies, in no small measure, the future of the electrical industry insofar as the small consumer of energy is concerned. Cities and towns have had the advantages of electrical service for years, and the greater proportion of individuals living in urban territory who desire service have already obtained it. Consequently new business in the cities among small users of power is obtained, as a rule, only after putting forth considerable effort. On the other hand, almost every farmer is a prospect, and in most cases these prospects have not as yet had an opportunity to sign a service contract.

This vast field, it seems, is now ripe for development, and to sit idly by without going out after this business is at least negligent. There are many problems yet to be solved in connection with rural line extensions, but these problems are yielding to solution where the effort is made to find their answer. On other pages of this issue appears an article indicative of what is being accomplished in Wisconsin, where concerted effort has been made to solve the various problems of rural service in that state. Wisconsin is bound to profit by the wise steps being taken—construction engineers, contractors, dealers, central stations and the public will all profit. And in addition to this the agricultural interests of the state will receive a new and almost priceless tool. It is much to be hoped that other states will see fit soon to follow in the paths of those already working out the rural problem, and so bring about the complete electrification of the entire country. It is not possible to estimate in dollars what the development of this service will mean to the country, but any thinking man must realize that electric service on the farm will go far to lessen labor burdens and cheapen the cost of farm products.

Two-Pole Setting for Mountain Lines

The Western States Gas & Electric Co., Eureka, Cal., which is under the able management of H. L. Jackman, states that after several years of service it has found increasing satisfaction in an unusual form of pole setting adopted for carrying high-tension transmission lines over very rough country, including mountain ranges. At the time the original construction was carried out it was impossible to secure anything except native timber—redwood. As this timber, when planted in the ground, would completely rot out at the ground line in about 3 years, the company adopted a form of setting which employs two poles set on top of the ground and guyed four ways. No part of either pole enters the ground, the base of the pole being given sufficient foundation to prevent this even under load. The form of construction adopted has been in vogue now for 12 years, and up to date no trouble has occurred; it has not even been necessary to tighten any of the guy wires. As replacement of old lines was called for, this same form of construction has been followed. The company states that the cost of the 2-pole structure is about two and one-half times as much as a single-pole structure. On the other hand, as the spans range from 150 ft. to as much as 3600 ft., with an average of probably 600 ft., this form of construction has been found cheaper than a single-pole installation built for 650-ft. spans. Much of the country traversed is most rugged, including several mountain ranges, and the company recommends the above mentioned form of construction for this class of work.

New Form of Grounding Resistance

The consensus of opinion abroad is now decidedly in favor of grounding the neutral point on all but the smallest 3-phase distributing systems. This is usually done through a resistance which limits the flow of current to the ground when a fault occurs; it also reduces the danger of pressure surges on the system. A new form of resistance has lately been put on the market which appears to have many good features to recommend it for this particular purpose. It was devised by an engineer connected with one of the large electricity supply companies in London.

This "carbon-powder earthing resistance," as it is called, takes the place of the iron grid resistance which is also used for grounding the neutral point. It is practically indestructible and will withstand prolonged discharges better than the metal resistances of the usual type, it is said. It takes up a small amount of space, the standard size of unit being 23 by 8 by 2⅝ ins., while a complete resistance capable of absorbing 100 kw. measures only 23 by 8 by 18 ins.

The negative temperature coefficient due to the

use of carbon permits of the initial current being some 30% lower than would be found necessary with an iron grid resistance, to provide against the possibility of a considerable increase in resistance due to temperature rise if the circuit-breaker does not operate instantly when the fault occurs. It is also claimed that the carbon resistance is cheaper to install than an equivalent resistance of any other pattern. American and Canadian engineers may do well to look into the matter, with a view to introducing something similar on this continent.

A Square Deal for Public Utilities

The recognition of a public utility as a public necessity, rather than an old hat to be kicked about the square by puny politicians and an unthinking public, has been accorded by a popular national weekly in the million-circulation class. *Collier's,* in a leading editorial recently, employed its best "take-the-people-into-your-confidence" style to point out some convincing truths under the caption, "A Square Deal for Public Utilities." Following are some excerpts from the *Collier's* editorial:

Of all the bills that come to you on the first of the month, which do you pay least willingly? Are not the two that excite the most distrust the gas bill and the electric-light bill?

There is an explanation, somewhere, of the lack of good will shown by the average community toward the public-utility company that serves it with light, heat, and power. One reason, we think, has never been fully stated: *If the power and light companies were owned and controlled by one or two men, and named after people, as the majority of our big enterprises are, we would be apt to have a more friendly feeling toward them.*

If you received your electric-light statement from the "Smith & Jones Electric Light Co.," and you thought it too big, you could go down to see Mr. Smith or Mr. Jones and feel that you had talked to headquarters. Perhaps Mr. Smith or Mr. Jones would be neighbors of yours. Perhaps their wives would know yours, or their children would go to school with yours. They might belong to your club, or fish in the same lake, or shoot over the same marsh, or drive the same kind of automobile that you do. You would have no trouble understanding each other.

But when you get a bill from the "Park Falls & Twin County Power & Light Co.," and it strikes you as being exorbitant, you feel that there is no one to whom to kick about it. The president of the company is probably only a minor stockholder. The directors are men of large affairs, no one of whom is in control. The majority of the stock is probably owned by investors scattered all over the country who may be as dissatisfied as you are.

The average employe of the average public utility knows that the company is looked upon with some hostility, and that its affairs are regulated by some commission, and that the company is continually called upon to explain, to customers like yourself, reasons why there could be no mistake in your last statemnt. He gets in a bad frame of mind, and perhaps ends the argument by saying: "If you don't pay this bill by the 10th, we will have to take out your meter."

A statement was made, a few weeks before this is printed, before a meeting of the Chamber of Commerce of the United States in Washington, that it will require $852,500,000 properly to equip the 1,250,000 houses and apartments which this country now needs with heat, light, transportation, and telephone facilities. This must come from the big and little pools of people's savings, and these pools will yield investment money only when tempted by securities which guarantee a fair return.

One of New York's newspapers has lately been printing letters from the chairmen of public-service commissions of different states which tend to show that the outlook for public-utility securities is on the mend, that public-utility problems are gradually being taken out of politics, and that a better public attitude toward public-utility enterprises is being developed. But haste is being made slowly.

As *Collier's* said some weeks ago, the American people have been "stung" a good many times by financial buccaneers in the public-utility field. That is no reason, however, why we should close our eyes to the marvelous achievements, as a whole, of our public-utility companies.

America must move forward, and the speed and comfort with which she moves will depend in a large measure upon her ability to produce, at low costs, heat, power, and light. Let each community give some thought to its public-utility situation, to the end that we may more quickly give a square deal, not only to the hand that lights the gas stove or turns on the electric switch, but to the investment pocketbook which furnishes the capital as well.

More power to *Collier's* and its comprehensive view of an industry that, with proper public appreciation, will speedily come into its own as the mother of all other industries.

French Electrical Exports and Imports

An interesting summary in tabular form, giving values of imports and exports, appears in the *Revue Generale de l'Electricite,* of Paris. A comparison is made between the first nine months for the years 1918, 1919 and 1920.

A study of the tables indicates that the total value of electrical materials imported during the first nine months of 1920 amounts to 137,000,000 francs, while that of the materials exported amounts to 140,200,000 francs. This excess of 3,000,000 francs of exports over imports is of particular interest because in 1919 the imports exceeded the exports by an amount of approximately 42,000,000 francs.

Considerable progress is indicated in the exportation of insulated wires and cables, carbon brushes, secondary cells and dry cells, with a corresponding decrease in the importations of these lines of electrical materials.

There is unfortunately no information available showing the destination of the exported manufactures; the custom-house statistics from which the tables have been compiled do not furnish these particulars. American manufacturers have not been accustomed to consider the French as serious competitors in the electrical industry, but the above quoted figures show a tendency which is well worth watching. Almost every foreign country is both a consumer of American electrical goods and a competitor with American manufacturers in other markets. Studying foreign markets and methods help to improve methods of service and competition.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

WILL CO-OPERATE ON INDUCTIVE INTERFERENCE MATTERS.

Joint Committee of N. E. L. A. and American Telephone & Telegraph Co. Meets to Formulate National Policy for Common Action.

A new era in the history of inductive interference was opened at the first meeting of a joint committee of representatives of the American Telephone & Telegraph Co. and of the National Electric Light Association at the New York City office of O. D. Young, vice-president of the General Electric Co., March 26. This meeting was called by agreement between the Public Policy Committee of the N. E. L. A. and the executives of the American Telephone & Telegraph Co. for the formulation of a national policy on all inductive interference matters between the telephone companies controlled by the American Telephone & Telegraph Co. and the electric light and power companies of the N. E. L. A. By the formulation of such a policy it is hoped to eliminate inductive interference controversies and litigation, thus materially benefiting the public by permitting both industries to achieve the greatest possible development without unnecessary conflict.

It was agreed that every effort shall be made by both interests to arrive at a friendly solution of all present existing differences. Careful study of all existing statutes, commission rules and regulations and court decisions which govern the question of inductive interference in the several states of the Union is to be made by Charles Neave, of New York City, who was engaged for that purpose by the unanimous vote of the committee.

A subcommittee composed of Bancroft Gherardi, vice-president of the American Telephone & Telegraph Co.; R. F. Pack, of Minneapolis, as representing the N. E. L. A., and four engineer members, two from the N. E. L. A. Inductive Interference Committee, to be associated with Mr. Pack, and two from the engineering organization of the American Telephone & Telegraph Co. to be associated with Mr. Gherardi. This committee will report on the general engineering features of inductive interference as a basis for the formulation of general rules of procedure. It was the unanimous belief of those present that a broad spirit of co-operation can easily overcome present legal and engineering inductive-interference problems.

The members of the joint committee are: O. D. Young, vice-president of the General Electric Co., New York City; E. K. Hall, vice-president of the American Telephone & Telegraph Co., New York City; R. H. Ballard, vice-president and general manager of the Southern California Edison Co., Los Angeles, Cal.; Martin J. Insull, vice-president of the Middle West Utilities Co., Chicago; Ben Read, president of the Mountain States Telephone & Telegraph Co., Denver, Colo.; W. W. Freeman, president of the Union Gas & Electric Co., Cincinnati; Bancroft Gherardi, vice-president of the American Telephone & Telegraph Co., New York City; H. M. Byllesby, president of the Byllesby Engineering & Management Corp., Chicago, represented by R. F. Pack, vice-president and general manager of the Northern States Power Co., Minneapolis, Minn.; Col. John J. Carty, vice-president of the American Telephone & Telegraph Co., New York City; Guy E. Tripp, chairman of the board, Westinghouse Electric & Manufacturing Co., New York City.

Those present at the March 26 meeting were: O. D. Young, chairman; Col. John J. Carty, R. H. Ballard, E. K. Hall, R. F. Pack, representing H. M. Byllesby; Bancroft Gherardi and M. H. Aylesworth, executive manager of the National Electric Light Association.

CONFERENCES HELD AT WASHINGTON ON WATER POWER LAW.

Water Power Development Committee of N. E. L. A. Requests Revisions of Act at Hearing Before Federal Commission.

Revisions of certain portions of the regulations for the development of water power under the new Water Power Law were requested by the Water Power Development Committee of the National Electric Light Association, of which Franklin T. Griffith is chairman, at a conference of the Federal Water Power Commission in Washington, D. C., March 25. Conferences preceded this request and additional conferences were held March 26 and during the week of March 28. Just prior to the close of the last national administration, the Federal Water Power Commission, which then was composed of Secretaries Baker, Meredith and Payne, prepared regulations which hydroelectric power experts of the country stated were about 70% workable, but which contained provisions that undoubtedly would prevent the development of waterpower projects.

As a result of the preliminary conferences, several modifications of the general plan of procedure, as outlined by the form of Federal Power Commission, were decided upon and drafted by the N. E. L. A. Water Power Committee. With these modifications as a basis, a complete set of regulations, suggested as a substitute for those now in effect, was prepared and presented in printed form to the Federal Water Power Commission. The argument and presentation was made by Chairman Griffith. This suggested set of substituted regulations was referred by the Federal Water Power Commission to its secretary, O. C. Merrill, who was requested by the Commission to present in written form any possible objections he might have to their adoption.

At the same time the Commission requested the N. E. L. A. Water Power Committee to submit in writing its argument and brief in order that the Commission might have before it all points in controversy, with a view to adopting such of the suggested substituted rules and regulations as would comply with the intent of the Water Power Act to encourage large investments in waterpower development, which is recognized to be of vital interest to the nation as a whole.

Conferences with Secretary Merrill, which were continued subsequent to the hearing before the Water Power Commission, were for the purpose of going over the suggested modified rules and regulations in detail.

In addition to Chairman Franklin T. Griffith, the members of the committee present included: T. W. Martin, Birmingham, Ala.; W. A. Breckenridge, Los Angeles, Cal.; Guy W. Talbot, Portland, Ore.; H. W. Freeman, Hartford, Conn. Associated in conference with the committee were Hugh L. Cooper; Senator J. T. Newcomb, Electric Bond and Share Co., New York City; Henry J. Pierce, Washington Power & Irrigation Co., Seattle, Wash.; A. G. Thurlow, Alabama Power Co., Birmingham, Ala.; R. H. Ballard, Southern California Edison Co., Los Angeles, Cal.; Fred W. Herbert, National Electric Light Association, New York City; W. H. Onken, *Electrical World*, New York City; Dr. George Hoxie, Southern California Edison Co., Los Angeles, Cal.; E. W. Clark, E. W. Clark and Co., Philadelphia. Attending the hearing on behalf of the Federal Water Power Commission were Secretary of War Weeks, Secretary of Agriculture Wallace, Secretary of the Interior Fall being unavoidably absent on account of sickness; also O. C. Merrill, executive secretary; William B. King, chief accountant; Major Call, attorney, and Colonel Kelly, chief engineer of the Federal Water Power Commission.

DISCUSS POWER-FACTOR PROBLEMS AT MILWAUKEE MEETING.

Papers and Reports Submitted at Closing Sessions of Annual Convention of Wisconsin Electrical Association—Officers Elected.

The concluding sessions of the thirteenth annual convention of the Wisconsin Electrical Association, held in Milwaukee last week, were given over to the presentation and discussion of the following papers and reports: Rural Line Extension committee Report; "Application of Induction Voltage Regulators," by Frank Hershey, General Electric Co.; "Street Railway Rate Schedules," by W. H. Sawyer, East St. Louis & Suburban Railway Co.; "Power Factor," by F. A. Coffin, sales manager of the Milwaukee Electric Railway & Light Co.; "Customer's Demand as a Factor in Rate Making," by L. B. Andrus, American Public Utilities Co., and "Electrical Merchandising," by C. E. Michel, sales manager of the Union Electric Light & Power Co., St. Louis.

A report of the first day's session appeared on page 513 of the March 26 issue of ELECTRICAL REVIEW.

At the banquet held March 23 there were present 325 people, Edgar A. Guest being the speaker on this occasion.

The following officers were elected: President, J. P. Pulliam; first vice-president, Harold L. Geisse; second vice-president, P. D. Kline; third vice-president, H. R. Ellis, and secretary-treasurer, William M. Chester.

NIAGARA FALLS PLANT DISCUSSED IN PITTSBURGH.

Interesting Points Brought Out Relative to Both General Features and Details of Construction and Operation.

The hydroelectric development of the Niagara Falls Power Co. was the subject discussed at a recent meeting of the American Institute of Electrical Engineers, Pittsburgh section, in the auditorium of the Chamber of Commerce. J. Allen Johnson, electrical engineer of the Niagara Falls Power Co., delivered a paper on the "Electrical Features of a 100,000 Horsepower Power Development." He said in part:

"The new extension to Station No. 3 of the Niagara Falls Power Co. consists of a generating station containing three turbines, each developing 37,500 hp. under a head of 215 ft., and driving 32,500 kv-a., 150 r.p.m., 3-phase, 12,000-volt, 25-cycle generators.

"The power thus generated is transmitted to a new substation at Echota, 3 mi. distant over a steel-tower line comprising six 3-phase circuits of 500,000-cir. mil. copper. At present two circuits are used for each generator at 12,000 volts, but clearances are provided for 88,000 volts.

"The Echota substation serves three functions: (1) To subdivide and distribute the power from the new plant; (2) to serve as a clearing house for the output of five generating stations aggregating 400,000 hp., and (3) to act as a future step-down substation. Careful attention has been given to the logical grouping of apparatus, and the unit idea has been carried throughout to assure reliability of service and simplicity of operation."

F. D. Newbury, manager of the power engineering department of the Westinghouse Electric & Manufacturing Co., delivered a paper on "Some of the Features of the Westinghouse Generator, Which Is One of the Three Largest Waterpower Generators in the World." He said in part:

"We are all interested in big things, and particularly in the biggest thing of its class. We are also, as a rule, interested in moving things as contrasted with stationary things. For example, there is more popular interest in turbines and generators than in transformers or switch gear. We have a good illustration of this fact in the preferences of the graduate students who come to us for training in design. It is much easier to interest these young men in such things as locomotives and turbogenerators than in stationary apparatus.

"So we are fortunate tonight in having a subject inherently interesting, and in having it presented in such an interesting way. Some of the more striking figures concerning this generator may be worth mentioning. The generator frame casting is a cylinder 22.5 ft. in diameter and about 9 ft. high. The overall height of the generator from the floor level to the top of the bear-

ing housing is 20 ft. 3 ins. The total weight of the generator is 325 tons. This is equally divided between the stationary part and the rotor. The complete rotating part consisting of the turbine runner, generator revolving field, and the common shaft, together with the unbalanced water thrust, which is in a downward direction, is carried by

General View of Generator Room and Exciter Gallery at Niagara Falls.

a thrust bearing of the Kingsbury type, located on top of the generator unit. This requires a very massive and rigid supporting bracket on top of the generator to carry this load. The total load on the thrust bearing is 240 tons, and the bearing area is such that the unit load is 360 lbs. per sq. in.

GENERATOR BEARINGS A FEATURE OF CONSIDERABLE INTEREST.

"The thrust bearing is one of the most interesting things about the generator, and it may be of interest to refer very briefly to the principle and construction of the Kingsbury bearing. This bearing is based on the principle established by an English physicist, Prof. Osborne Reynolds, in 1886, that oil, because of its adhesion to the journal, and because of its viscosity, is dragged by the rotary motion of the journal into a wedge-shaped space between it and the brass. The

Rear View of Echota Substation Showing Five Connected Switch Houses.

wedge-shaped oil film is about twice as thick at one end of the bearing shoe as at the other, and varies from a few thousandths to less than one-thousandth of an inch at the thin end. This action sets up a pressure in the oil film, which, in turn, supports the load. It completely separates the bearing surface so that there is no metallic contact. This wedge-shaped film of oil is absolutely essential to effective automatic lubrication, and no great load can be borne on the bearing except with the accompaniment of high friction, heating and wear.

"It is apparent in a thrust bearing, consisting of a simple rigid collar and runner, that the bearing surfaces are parallel under all conditions, and the formation of the necessary wedge-shaped oil film is impossible. Kingsbury applied this principle to the thrust bearing by dividing the stationary part into a number of separate pivoted segments, each of which automatically tilts at the best angle, depending upon the speed and load conditions.

"The outside diameter of the stationary shoes of this Niagara Falls bearing is 43 ins., and this is the customary way of designating the bearing size. From the standpoint of supported load this is one of the largest bearings in service. The load on this bearing is 480,000 lbs.

"So far as the generator itself is concerned, there is little, except for its size, that is unusual, or that involves any difficulty as a design problem. There are two features of design in which this generator differs from other generators of its class that may be worth comment. These are the type of rotor construction, and the type of armature-coil insulation and mechanical bracing.

"One of the distinctive features of this generator is the heat-resisting qualities of the armature-coil insulation. Mica is used as the insulating material, beginning with a bare copper conductor. This mica insulation is regularly guaranteed for operation up to a temperature of 150 deg., and it has been successfully tested up to 300 and 400 deg. for short periods. It was used in accordance with the policy to provide the maximum possible operating factors of safety."

George S. Anderson, director of publicity of the Niagara Falls Power Co., showed colored moving pictures made by the Niagara Falls Power Co.

ELECTRIC FLATIRONS TO BE GIVEN THOROUGH TESTS.

System of Examination to Determine Qualities of Various Irons Worked Out in Considerable Detail by N. E. L. A.

The standardizing and testing division of the Merchandise Sales Bureau of the National Electric Light Association is sending out a communication to various manufacturers of electric flatirons, advising them of a series of tests to be conducted by the Electrical Testing Laboratories, New York City, under the direction of the division. Only a few makes of irons, possibly 12, will be tested for the division, but all manufacturers may have their product given the standard tests if desired. Anyone interested in having tests made should communicate with either R. S. Hale, chairman of the division, 39 Boylston street, Boston, or with the Electrical Testing Laboratories, East End avenue and 80th street, New York City.

The tests to be made will cover general features such as weights of the complete iron and its various parts, shapes of various details, and finish. Tests of ratings will be made with both alternating and direct current, giving attention to various important details. Very exhaustive tests will be made of the thermal characteristics of the irons, the idea being to determine what the various

devices will do under normal and special conditions. Heating and cooling curves will be taken in connection with other thermal tests. Other tests will check up on efficiency, stability and insulation. Durability will be investigated in a thorough manner, subjecting the entire unit and its various parts to comprehensive and exhaustive tests resulting in ultimate destruction.

The division plans to publish the results of the tests of all of the irons without naming the manufacturers or brands. It is hoped that the performance of these irons, as given by the test results, will serve as a basis for later judgment as to the quality of irons which may be tested by central stations, contractors or others. The standardizing and testing division cannot afford to test all the irons offered, but it has no objection to any manufacturer arranging directly with the Electrical Testing Laboratories to have his irons tested at the same time for his own private information. In such an event the division will be very glad to include the results of these tests in its report, if the manufacturer so elects, according to Mr. Hale. It is understood that the charge for doing this work will be $300 per brand. If any manufacturer has tests made elsewhere the division will receive the results for its information, and if the tests are made in the same way as the standard tests the division will include the results of these tests along with those it has made on its own account, indicating, however, the source of the data. If the tests are made elsewhere than at the Electrical Testing Laboratories it is desirable that the manufacturer having such tests made get in touch with them or with Mr. Hale as quickly as possible in order that all tests may be made in the same way and the results be properly comparable.

ENGINEERS DISCUSS INDUSTRIAL RELATIONS.

American Institute of Electrical Engineers and American Society of Mechanical Engineers Hold Joint Meeting in New York City.

Industrial relations from the viewpoint of the engineer and the educator was discussed in a public forum in the Engineering Societies building, New York City, Friday evening, March 25, when another in the series of joint meetings being held under the auspices of the New York section of the American Institute of Electrical Engineers and the Metropolitan section of the American Society of Mechanical Engineers, took place.

Walter Rautenstrauch, professor of mechanical engineering, Columbia University, and vice-president of the J. G. White Management Corp., who acted as presiding officer, made an appeal for an honest day's work from labor and stated that only when employers and employes recognized obligations to each other and the public and bent their best energies toward carrying out these obligations, would the proper industrial relations be established.

Dr. Franklin H. Giddings, professor of sociology, Columbia University, in presenting the social history of labor organizations, urged engineers to initiate a movement to bring capital and labor closer together. Dr. Ira N. Hollis, president of Worcester Polytechnic Institute, and past president of the American Society of Mechanical Engineers, spoke on the "Rise of Industrial Workers in Organized Society."

Dr. S. M. Lindsay, professor of social legislation, Columbia University, spoke on "Recent Legislative Enactments Affecting Industrial Relations." A joint paper on "Developments in Organizing Personal Relationships in Industry" by L. P. Alford and E. W. Tree, *Management Engineering*, was read. A. L. DeLeeuw, consulting engineer, advocated some form of definite contract between employer and employes by which both the amount of product and compensation are properly fixed and their relation maintained.

RESOLUTION ON INTERCHANGEABLE FIXTURE DEVICE.

The executive committee of the National Association of Electrical Contractors and Dealers has adopted the following resolution:

"Resolved, that the Executive Committee of the National Association of Electrical Contractors and Dealers is opposed to the development by manufacturers of any detachable fixture device unless the same be fully interchangeable."

In reference to this resolution, General Manager W. H. Morton states: "The feeling of our committee was that the development and marketing of several detachable fixture supports that were not interchangeable would be a serious detriment to the industry, causing expense, inconvenience and annoyance to both the seller and the user of such devices. On this account the committee felt that it would be better not to have any such devices produced unless they could be produced by concerted action on the part of the manufacturers, resulting in any devices that were put on the market being entirely and fully interchangeable."

Announcement has been made that after April 1 the address of the National Association will be 15 West 37th street, New York City.

ELECTRICAL CONFERENCE HELD AT BOSTON.

Opportunities for Dealers and Central Stations in the Electrification of the Home Discussed at Merchandising Conference.

A merchandising conference was held in Boston recently under the auspices of the General Electric Co., Trumbull Electric Manufacturing Co., Edison Electric Appliance Co., Pettingell-Andrews Co., Electric Vacuum Cleaner Co., and the Hurley Machine Co. The conference, which was called for the purpose of stimulating interest in the electrical industry, attracted about 500 people, among which were contractor-dealers from New England, central-station representatives, manufacturers, jobbers, etc.

H. H. Russell discussed the subject of "Opportunities for Dealers and Central Stations in the Electrification of the Home," and W. D. Yates spoke on "Winning Your Way to Better Business." Other speakers included H. B. Kirkland, A. L. Powell, H. G. Bevan, G. P. Norton, T. J. McManis, R. E. Harrington, D. W. MacCready, H. S. MacWhorter and others.

A feature of the conference was the traveling

electrical exhibit now on a tour of the country. A miniature theater, with a revolving stage divided into four sections, showed the interior of various rooms in the modern home, store and factory, contrasting the old-time settings with their inadequate illumination and lack of convenience with brightly lighted rooms equipped with every variety of electrical appliance.

CONVERSION APPARATUS DISCUSSED AT A. I. E. E. MEETING.

At the 368th meeting of the American Institute of Electrical Engineers held in New York City recently, the subject of "Developments in Conversion Apparatus for Edison Systems" was comprehensively presented by T. F. Barton, General Electric Co., in a lengthy paper. H. P. Leversidge, chairman of the Power Stations Committee, under whose auspices the meeting took place, presided, and the written discussion of B. G. Lamme, Westinghouse Electric & Manufacturing Co., presented by Herman C. Albrecht, treated the subject in a historical manner, showing how the present-day development was trending back toward the practice of 20 odd years ago.

Others taking part in the discussion which followed were Albert A. Nimis, Nimis & Nimis, New York City; Frank D. Newbury, Westinghouse Electric & Manufacturing Co.; Raymond Bailey, Philadelphia Electric Co.; Philip Torchio, New York Edison Co.; Selby Haar, mechanical and electrical engineer, New York City; D. W. Roper, Commonwealth Edison Co., Chicago.

CONTRACTORS TO ELECT OFFICERS.

The Southern California Electrical Contractors and Dealers, of which E. P. Tyler, 628 Union Oil building, Los Angeles, Cal., is secretary, will meet this week to elect officers.

ELECTRIC PROPULSION PROBLEMS DISCUSSED BY ENGINEERS.

The subject of "Electric Propulsion for the Merchant Marine" was discussed by Wilfred Sykes, executive engineer of the Steel & Tube Co. of America, at the meeting of the Chicago Section, American Institute of Electrical Engineers, held March 28 jointly with the electrical engineering section of the Western Society of Engineers. Mr. Sykes was closely associated in the development of our merchant marine during the war, and spoke of the possibilities, limitations and special requirements in reference to the shipping problems of the interior.

EXPOSITION TO SHOW ELECTRICAL ADVERTISING METHODS.

Plans are rapidly taking shape for the electrical advertising display which the New York Edison Co. is to hold in its Irving place showroom during the week of May 2-9. Practically all the manufacturers of signs have accepted the invitation to take part, and an interesting exhibit of electrical advertising methods is sure to result. Roof signs will be shown with their flashers in actual operation; store-front signs will make up another part of the exhibit, and a third department will include the so-called directional signs.

An effort is being made to have an exhibit of some of the early sign material, and Major William J. Hammer, who as Edison's representative in London in 1881 built the first electric sign, has been invited to contribute material from his historical collection. As 1921 is the 40th anniversary of the making of the first sign, such an exhibit will add greatly to the interest of the show.

COMING CONVENTIONS.

Kansas City Electrical Show. First annual electrical exposition, Convention Hall, Kansas City, Mo., April 18-23. Manager, Sam Furst, Electrical Trades Exposition Co., 802 Broadway, Kansas City, Mo.

American Electrochemical Society. Spring meeting, Atlantic City, N. J., April 21-23. Headquarters, Hotel Chalfonte. Secretary, Joseph W. Richards, Lehigh University, Bethlehem, Pa.

Missouri Association of Public Utilities. Annual convention, Kansas City, Mo., April 21-23. Secretary, F. D. Beardslee, 1500 Grand Avenue, Kansas City, Mo.

American Washing Machine Manufacturers' Association. Meeting at Sherman Hotel, Chicago, May 18-19. Secretary, Enoch B. Seitz, Otis building, Chicago.

Southwestern Electrical and Gas Association. Annual convention, Galveston, Tex., May 18-21. Headquarters, Hotel Galvez. Secretary, H. S. Cooper, 403 Slaughter building, Dallas, Tex.

American Society of Mechanical Engineers. Spring meeting, Chicago, May 23-26. Headquarters, Congress Hotel. Assistant secretary, C. E. Davies, 29 West 39th street, New York City.

International Railway Fuel Association. Annual convention, Chicago, May 24-26. Headquarters, Hotel Sherman. Secretary, J. G. Crawford, 702 East 51st street, Chicago.

Electrical Supply Jobbers' Association. Thirteenth annual meeting, Hot Springs, Va., May 25-27. Headquarters, The Homestead. General secretary, Franklin Overbagh, 411 South Clinton street, Chicago.

Pacific Coast Geographic Division of the National Electric Light Association. Annual convention, Del Monte, Cal., May 25-27. Headquarters, Hotel Del Monte. Secretary, L. H. Newbert, 445 Sutter street, San Francisco.

National Electrical Light Association. Annual convention, Chicago, May 31-June 3. Headquarters, Drake Hotel. Executive manager, M. H. Aylesworth, 29 West 39th street, New York City.

Tri-State Water and Light Association. Annual convention, Asheville, N. C., June 15-16. Secretary, W. F. Steiglitz, Columbia, S. C.

National Fire Protection Association. Annual convention, San Francisco, June 14-16. Secretary, Franklin H. Wentworth, 87 Milk street, Boston.

Canadian Electrical Association. Annual convention, Quebec City, June 15-17. Secretary, Eugene Vinet, Power building, Montreal, Que.

American Institute of Electrical Engineers. Annual convention jointly with the Pacific Coast convention, Salt Lake City, Utah, June 20-25. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

North Central Geographic Division of the National Electric Light Association. Next convention, Duluth, Minn., June 21-23. Headquarters, Spaulding Hotel. Secretary, H. E. Young, 15 South Fifth street, Minneapolis, Minn.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 12-15. Headquarters, Breaker's Hotel. Secretary, D. L. Gaskill, Greenville, O.

National Association of Electrical Contractors and Dealers, Anniversary convention, Buffalo, N. Y., July 20. Secretary, W. H. Morton, 110 West 40th street, New York City.

Illuminating Engineering Society. Annual convention, Rochester, N. Y., Sept. 26-30. General secretary, Clarence L. Law, 29 West 39th street, New York City.

CONTRACTING-CONSTRUCTION

A Department Devoted to Various Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

INDUCTION MOTORS SUITABLE FOR SEVERE SERVICE.

Alternating-current motors of the polyphase induction type admirably meet the conditions of operation in bakeries, candy factories and other plants where sticky material is handled. The operating characteristics of direct-current motors also permit of their use, except that commutator trouble has been experienced in many instances due to pasty coatings forming on the commutator and resulting in considerable sparking trouble. Inclosed motors can be used but these, of course, reduce the motor capacity and call for greater care and attention in operating. Suspending motors from the ceiling or mounting them on raised platforms eliminates much of this difficulty, but makes belt drives necessary in cases where geared connections would perhaps be preferable.

The polyphase induction motor, on the other hand, can be used without inclosing and will operate satisfactorily even after the windings and all parts of the machine have become coated. However, where belt drives are to be used it is advisable to raise the motors out of the range of flying particles, if this can be done without sacrificing conveniences of operation or other advantages.

PULLING IN LEAD-COVERED UNDERGROUND CABLES.

Power Winches Commonly Used for Heavy Pulling —Ducts Cleaned, Rodded and Wired in Advance of Cable Work.

The demand for subsurface construction in cities and improved suburban localities has involved many difficulties, particularly in connection with the installation of underground electric communication, light and power systems in which the maintenance of a high degree of insulation is a vital factor. When such systems were first installed the methods were crude, costly and none too reliable, but gradually satisfactory schemes were worked out, special tools and appliances developed and at length a whole new industry has been created.

In the early days various materials were employed to insulate and protect the conductors, but now lead-covered cables are almost universally used, and with the demands for a large number of conductors in telephone and telegraph working and the necessity of transmitting heavy currents in modern power systems these cables are frequently quite large. The "pulling-in" of a large lead cable not only requires considerable power, but extreme care is essential to prevent injury to the sheath, which would permit the subsequent entrance of moisture and cause the failure of telephone cable, and in power work even more disastrous consequences.

The practice of pulling-in cables by hand windlasses has been generally abandoned as too slow in jobs of any magnitude, and reliance is now usually placed on small power-driven portable winches. Several manufacturers of motor vehicles offer trucks of from 1.5 to 5 tons capacity equipped with a winch which may be operated from the truck engine. Winches mounted on horse-drawn trucks and geared to gasoline engines also mounted on the truck are also used. The engine may be either of the stationary type with hit-or-miss governor, or of the marine type with throttle control. The latter type is ordinarily smaller, but in either case the outfit usually takes up much of the space on the truck and the transportation of tools or material is correspondingly limited, whereas in the case of the automobile truck only a small portion if any of the floor space is occupied by the winch.

Engine or Motor-Driven Winches Mounted on Work Truck.

Engines of from 5 to 15 hp. are usually employed, except in the case of automobile trucks, where the engine power is governed by the requirements of the truck rather than by those of the winch. Whatever the source of power, the gear ratio should be such as to give a peripheral drum speed of from 50 to 90 ft. a minute. Slower speeds require too much time for pulling-in, and higher speeds do not permit of proper inspection of the cable as it comes off the reel. Furthermore, with high speeds, if the cable binds or jambs at the duct entrance, serious damage is liable to be done before the pulling-in can be stopped. All engine-driven winches should be equipped with a friction clutch so that the drum can be stopped or started independently of the engine.

Another type of cable-pulling rig, and one that is quite efficient and economical, employs a storage-battery-driven motor-operated winch. Such winches may be mounted on either electric or gasoline trucks, it being common practice to operate the pulling winch from the regular service battery when used in connection with an electric truck. In case a gasoline truck is used a storage battery must be mounted some place on the truck. Motor-driven winches have the advantage of not requiring a clutch, the speed of the pulling and the force exerted being regulated entirely by the winch-motor controller. With an ammeter inserted in the motor circuit the operator soon learns to estimate approximately how great a force is being exerted, and can stop the winch before damage is done in case the cable becomes lodged in the duct.

Advance Rodding of Ducts Saves Much Construction Time.

Previous to the pulling-in it is necessary to rod the duct to be used in order to establish a line by which to draw in the pulling-in rope. This should

be done considerably in advance of the pulling-in so as not to delay that work. Various types of jointed rods are on the market. Some terminate in threaded brass nipples, a male thread on one end and a female thread on the other, but more commonly some form of interlocking joint is provided which permits of more rapid connection and disconnection than with the screw type. The rods are pushed into the duct from one manhole and when they appear at the adjacent hole a wire is fastened to one end and pulled in. Where more that one length of conduit is to be rodded, and where the ducts on one side of the manhole register with those on the other, the rods need not be unjointed at each manhole but may be pushed through from one length of duct to the next until the end of the run is reached, or until a corner makes it necessary to unjoint the rods and make a fresh start.

Some types of rods are equipped at each end with rollers to facilitate the rodding if the ducts are clean. If the ducts are choked with mud and sand it is necessary to clean them or to employ a type of rod in which the joint is little or no larger than the rest of the rod. Screw rods are particularly satisfactory in this respect, and where choked ducts are encountered it is frequently quicker to employ them and clean the ducts later with a mandrel on the pulling-in rope than to clean the ducts in advance of the rodding.

Many types of cleaning tools are commercially available, usually consisting of some form of cylinder placed on the first rod. The cleaner is pushed into the duct until filled with the debris. It is then withdrawn and emptied and the operation repeated until the duct is clear. This is obviously a slow and laborious process.

Annealed iron wire is ordinarily used in connection with the rodding. If the ducts are dry or if the cable is to be pulled in within a few weeks after the rodding it is unnecessary to employ galvanized wire, but if the ducts are wet and the cable work is not to follow within two or three weeks the wire is liable to be so weakened by rust as to break when drawing in the pulling-in rope. At the manholes care should be taken, especially if the ducts are wet, to keep the wire in one direction from contact with that from the other, as in that way the wire is less liable to deterioration from electrolysis.

Care Required in Setting Up Cable Reels to Avoid Damage.

When the pulling-in is to be started, the cable reel should be set up in line with the duct run and on the side of the manhole toward the pull. This type of set-up is particularly important in the case of large cable, as any other arrangement results in reverse curves in the cable and considerably complicates the feeding. Care should be taken to have the axle bar level, as otherwise the reel will slip toward the lower side as it turns and bind against the support. If the cable is large two men should be assigned to handle the reel as the cable is pulled in. One man should sit on the edge of the manhole to keep the cable from scraping. This man should be in charge of the operations at that point, and should be in a position to signal the man handling the winch and should direct the men at the reel as to the proper speed to pay off the cable. A man should also be stationed in the manhole to guide the cable into the duct.

Before the pulling-in can be started it is necessary to draw the pulling-in rope into the duct, using the wire installed by the rodding gang. This can be done conveniently while the reel is being set up. The pulling-in outfit should be stationed at the proper manhole in position for the pull and the pulling-in rope, previously coiled on the drum, should be attached to the end of the wire in the duct. The pulling-in rope may then be drawn in by one or two men if the ducts are clean. The wire should not be coiled in the distant manhole, but should be pulled out over the ground as this is much quicker and allows the wire to be coiled later without delaying other operations. If the ducts are to be rodded when the pulling-in is done the wire is sometimes unnecessary, as the pulling-in rope can often be attached directly to the rods and drawn in. The rodding, however, ordinarily consumes so much time that the saving in wire is more than offset by the delay to the pulling-in gang. It is usually economical to rod in advance, even for only one length of cable.

Ducts Must Be Clean to Permit Easy Passage of Large Cables.

If the ducts are thoroughly clean the cable may be attached directly to the pulling-in rope, but it is generally better to place a mandrel between the rope and the cable. In the case of ducts which are not thoroughly clean a mandrel is essential to clear the duct and prevent injury to the cable from pieces of duct or foreign matter. When the ducts are badly choked with sand or mud the mandrel should be pulled through without the cable as many times as required to properly clear the duct. The rodding wire should be attached behind the mandrel in order to again draw in the pulling-in rope.

Various set-ups may be used for pulling-in work. One set-up, requiring two pulleys, involves the mounting of one pulley at the intersection of a horizontal line running through the duct to be used and a vertical line through the center of the manhole opening. This pulley is usually supported in place by being attached to a beam blocked in place inside the manhole. The second pulley is blocked in place at or near the center of the manhole opening. Another type of set-up involves the use of a longer beam having two pulleys attached to the single beam. This beam is blocked in the manhole with one end extending up through the opening, one pulley being attached at a point above the ground level with the second pulley mounted opposite the center of the duct to be used. It is common practice to make these pulley beams of two pieces of channel iron or two timbers bolted together with a space between wide enough to receive the pulleys. Holes are drilled through these beams every few inches to take a bolt to serve as a spindle for the pulleys. The holes so distributed along the length of the beam make it comparatively easy to place the pulleys in the proper location. In any case, and with any type of set-up, it is essential to brace the pulling beam or beams firmly in place in order to avoid the chance of their slipping with possible serious injury to workmen or damage to equipment.

With the pulleys set in place the pulling rope

is threaded under the lower pulley, over the upper one, and then is carried two or three times around the winch drum, the loose end being drawn taut by hand to give a firm grip on the moving drum. By taking up hard on this loose end of the rope the full force of the winch can be brought into play, and by slacking off the pull may be reduced by any desired amount down to no pull at all, thus keeping the strain on the cable under full control of one man at all times.

Ordinarily no set-up brings sufficient cable into the manhole on the inital pull to permit of properly racking the cable around the hole with the splice at the center of the side wall. This does not refer, however, to cases where some form of hook or loop, known as a pulling-in iron, is set in the end of the manhole just below the duct entrance. By attaching a snatch block to the pulling-in iron the cable can, of course, be drawn practically across the manhole, but such an arrangement is not satisfactory for large cables as the end wall will not ordinarily stand the strain imposed. It is therefore necessary with cables of considerable size to make a second pull. This can be done by moving the cable grip back a few feet and taking a short pull. This method is quite satisfactory where an "open-end" woven-wire grip is used, but where a grip is employed which involves beating down the cable sheath it is necessary to adopt other means, such as making a temporary hitch with a rope winding. Where several lengths are to be pulled in a convenient method consists in making the second pull through the duct in the adjacent section before that section of cable is pulled in. The pulling-in rope and the grip will, of course, be in position for the purpose, and it is a short matter to pull the cable across the manhole, remove the grip and place it on the second cable ready to be pulled into that section.

Woven-wire grips, of which there are several kinds on the market, are satisfactory for ordinary work. Such grips, however, hold only on the sheath, and where the situation involves long duct sections and heavy cable, and particularly where the ducts are not clean, it is well to use a grip which takes hold on the cable core as well as on the sheath, otherwise the sheath may be pulled off the end. Such a grip can be made by beating two or three circular grooves into the sheath, the first 6 ins. from the end and the second 10 ins. from the first, etc., and braiding on No. 10 or No. 12 iron wire, forcing the wire into the grooves by circular wrappings. The wire should be braided, i. e., laid on in criss-cross fashion and each strand should be carried through a ring or eye 6 ins. from the end of the cable, into which the pulling-in rope may be fastened.

Mandrels are usually of hard wood with metal caps at the end. They should be provided with a bolt passing completely through the mandrel and with an eye at each end. The eye should be welded, as the strain may be easily greater than a bent eye could withstand. The shape and size of the mandrel will be governed by the duct, but, in general, the outside diameter of the mandrel should be about one-fourth less than the inside diameter of the duct.

Ordinary 0.75 or 1-in. manila rope may be used for pulling-in small cables, but for heavy work 0.375 or 0.5-in. steel hoisting rope should be employed. When the cable has been pulled in it should be tied up to keep the end off the ground, unless it is to be spliced within a day or two. The various lengths should also be connected together electrically and to any other cables which may be present in order to reduce the possibility of electrolytic corrosion.

OPERATING TEMPERATURES OF LOW-VOLTAGE CABLES.

Paper-Insulated Cables Capable of Withstanding High Temperatures Where Dielectric Stress Is Comparatively Low.

Commonly accepted standards of cable operating practice were shown to be overly conservative in the case of low-voltage equipment, in a paper presented by Philip Torchio, chief electrical engineer of the New York Edison Co., before the midwinter convention of the American Institute of Electrical Engineers. Mr. Torchio reviewed a number of interesting experiments made by himself and others, presenting a large amount of data in both tabular and graphic form, and then drew some quite interesting conclusions. In drawing these conclusions the operating experiences of the New York Edison Co. and other large concerns were fully considered, as well as the special experimental work. The conclusions were as follows:

"After having reviewed all of the foregoing data, including the Steinmetz and Lamme report, the British Engineering Standards Committee tests, the surveys of large operating companies, and all special tests and findings herein presented, I submit that the permissible operating temperatures of impregnated paper insulation, in which dielectric stress is low, are to be a function of the load factor at which the cable operates. The load factor for cables used in systems of distribution is intended to be the ratio between the yearly average load and the maximum load on the cable. It is certain that a load factor of say 33%, with seasonal winter peaks and correspondingly smaller maximum loads for the rest of the year, will produce an average temperature on the cable considerably below 85 deg. C., so that a limit of say 105 deg. C. at peaks for 33% load factors is unquestionably safer than 85 deg. C. continuously, as allowed by the present Institute Rules. The proposed plan corresponds with the well established practice of rating electrical apparatus at a temperature rise of, say, 40 deg. C. for continuous loads and from 55 to 65 deg. C. for 2 or 3 hrs. overload. Machinery so designed has given excellent service for the last 25 years.

"I should suggest for consideration for impregnated-paper low-tension cables the temperature limits in function of the load factor of the cable, as follows:

105	deg. C.	for load factors around	33%
95	deg. C.	for load factors around	50%
90	deg. C.	for load factors over	66%

"The suggested temperature limits may perhaps be presented in a more general form by working back from the load factors to corresponding values of rise of temperature allowable for normal loads and overloads for specified hours. I *prefer to use the load factors* as they are fundamental in the determination of the most economical current density in cables as per *the Kelvin law which prescribes lower current density, and consequently lower losses and smaller temperature rise, the greater the load factor.* This gives a balance between economy and heat stress upon insulation. However, the important principle to be established is that the limiting temperature must be lower the greater the number of hours the insulation works at that temperature.

"The shortcomings of the present rules are that for cables they do not allow any rise of temperature for brief overloads above the 85 deg. C. which is the limit for continuous operation, while they allow for the same type of insulation in machinery 105 deg. C., continuous."

APPLIANCES and DEVELOPMENTS

New, Improved or Interesting Electrical and Mechanical Apparatus and Devices, and Applications of Equipment and Methods in Practice

Automatic Counter for Use in Industrial Plants.

In a folder bearing the title "Squeezing Profits from Production the Root Way," the C. J. Root Co., Bristol, Conn., describes the advantages to be derived from utilizing the "Bristol" counter in

"Bristol" Automatic Counter.

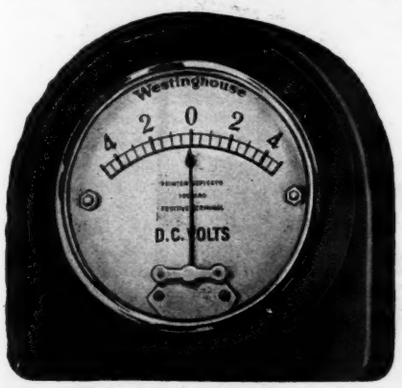
an industrial plant. The following statements are extracted from the folder:

Whatever your unit of production or operation, whether it be counting or measuring as your product is being manufactured, wrapped, packed or conveyed—whether you are registering revolutions or strokes of pumps, engines, dynamos, shafts, etc.—Root counters give you an accurate count of what has been done. Root counters work as the machines operate—and "when the job's done it's counted" accurately and indisputably.

Root counters furnish a searchlight to your cost department in finding hidden production leaks. They prevent over-runs and all the waste of time and material that over-runs involve. They prevent, too, under-runs and the disputes and annoyance that come with under-runs. The operator will forge ahead when he gets paid for his increased efficiency. Root counters are an incentive to the worker, and wages paid on a basis of units produced mean profit for the employer and employe.

Westinghouse Instruments for Testing Purposes.

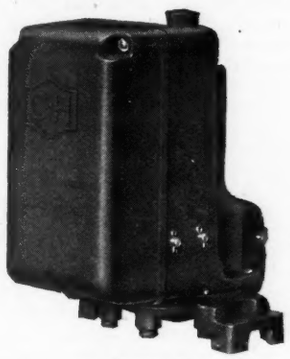
For tests on batteries for automobiles, farm-lighting equipment, etc., the type PI portable instruments, recently placed upon the market by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., have been found desirable. There are no springs or moving coils in these instruments, and great simplicity and ruggedness are obtained. Dead-beat indications are assured because of an efficient damper. A moving soft-iron vane polarized by a stationary permanent magnet and deflected over its scale by the action of a stationary current coil furnishes the moving element. Other uses for these instruments are for tests on electrical toys, radio apparatus and amateur experimenting. These instruments are assembled in moulded composition cases, which are 2.75 ins. overall. The instruments weigh only 6 ozs.



Type PI Portable Electrical Instruments.

C-H Pressure-Operated Switch of Compact Design.

A pressure regulator of the diaphragm type, which has recently been developed by The Cutler-Hammer Manufacturing Co., Milwaukee, is much more compact and simpler in design than other C-H diaphragm-type regulators. This new device is arranged for easy mounting, and its three overall di-

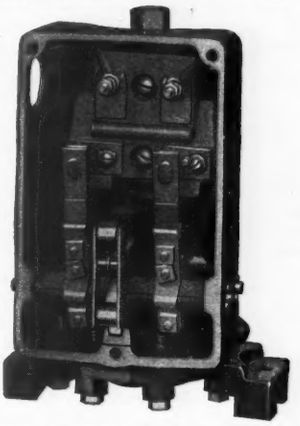


C-H Pressure-Operated Switch for Pumps and Compressors.

mensions are 6, 6.5, and 8 ins. It is used with motor-driven pumps or compressors controlled by a main-line magnet switch or some other suitable automatic starting device. It has two poles, which enables it to be used also for connecting small a-c. and d-c. motors directly to the line.

Air, water, or other fluid under pressure is conducted into a chamber in the base of the regulator, and the pressure acts against a rubber diaphragm and compresses a spiral spring, the normal compression of which can be changed by means of an adjusting nut to obtain various values of opening pressures up to 60 lbs. per sq. in. When the switch is closed and the pump or compressor operating the pressure builds up, and when the adjusting spring has been compressed to a certain point the switch snaps open and stops the motor. When the pressure has fallen to a predetermined point the switch closes with a quick action and the pump or compressor again operates to build up the pressure in the system.

This "snappy" make-and-break action of the switch is accomplished by an arm carrying a roller which is held in tension against a cam mounted on the operating shaft of the switch. The movement of the adjusting spring is transmitted to the roller which moves along the surface of the cam. When the



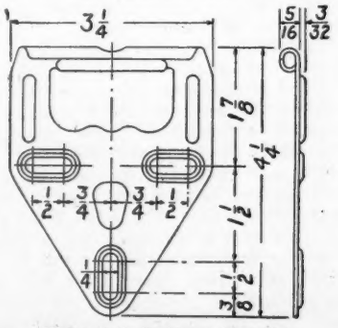
Pressure-Operated Switch With Cover Removed.

opening or closing pressure is reached the roller passes a peak on the cam and gives the latter a quick turn, thereby opening or closing the switch. A good contact pressure is maintained up to the instant the switch is opened. The difference between opening and closing pressures is about 20 lbs.

The entire mechanism of the regulator is inclosed in a cast-iron case arranged for the entrance of conduit. Terminals and fingers are exposed by taking off the cover of the case, which necessitates only the removal of three screws. Regulators are at present made for 60 lbs. maximum service, and it is expected that they will shortly be provided for use on systems up to 200 lbs. pressure.

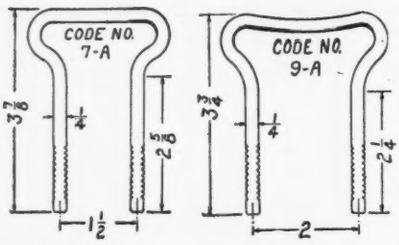
Narrow Stamped and Wire Types of Battery Handles.

The Mueller Electric Co., 2135 Fairmount road, Cleveland, has recently placed on the market three types of battery handles. The No. 6-A, described as the narrow stamped type, offers the manufacturer an opportunity to standardize on one handle only for use on



Type 6-A Battery Handle.

all his batteries. The Mueller company states that slots in place of holes are something new, making it possible to use this handle on boxes drilled for practically any other design of handle. The slots also allow for any inaccuracies in the drilling of the box and thus quicken assembly. The handles are



Type 7-A. Type 9-A.

lead coated by a special dipping process and are deeply ribbed for strength, the grip being smoothly formed and well rounded. Upset screw holes are provided, which strengthen where the usual countersinking may have a tendency to weaken.

The No. 7-A and 9-A handles are of the wire type. The deep serrations on the legs are for taking the lead which holds the handles in position in the side of the box. These wire handles are produced automatically in quantity lots.

Leaflet on Squirrel-Cage Motor Starters.

"Type F Automatic Starters for Squirrel-Cage Induction Motors" is the title of leaflet 1660-A, which is being circulated by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. These starters are the transformer type of 400-hp. rating, 22 volts maximum; and the resistance type, 35-hp., 550 volts maximum. The leaflet illustrates the use of the gauge type pressure regulator, the inclosed type float switch, the diaphragm pressure regulator and the push-button station.

A Cage-Operated Electric Hoist on Monorail Track.

The cage-operated monorail hoist, made by the Roeper Crane & Hoist Works, Reading, Pa., has been designed to meet the requirements of the ordinary manufacturing plant or warehouse, and is not intended for high-speed handling of coal and ore with buckets or the manipulation of electric magnets. It is a complete self-contained, self-propelling hoist unit and represents late practice in both mechanical and electrical design. The hoist and trolley is the same unit as is used for the floor-controlled type of equipment made by this company, except that the controllers are mounted in the operator's cage and magnet brakes are used on both hoist and trolley. The operator's cage is suspended from a separate or trailer trolley joined to the hoist trolley by means of a flexible connection. This promotes the comfort of the operator in that the cage is not subjected to the jars and jolts endured where the cage is suspended direct from the hoist trolley.

As this unit is designed for a single I-beam or monorail track its use is not limited to a given space as is the case with a traveling crane, since the I-beam track can be carried overhead anywhere. It can be used in a building or from one building to another in space otherwise of no use whatever. It has certain advantages over an industrial railway, as it does not obstruct the floor by tracks or trackage space. In many cases such an equipment will accomplish results equivalent to an increase in plant at a cost for installation which is merely nominal and with an operating cost almost negligible as compared to the savings in time, labor and floor space realized by its use.

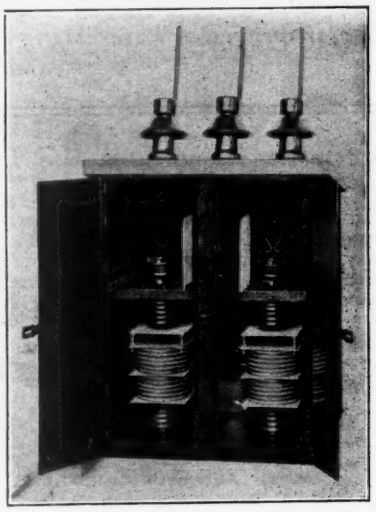
New Type of Underground Conduit.

The North American Electrical Products Corp., 120 Broadway, New York City, has placed on the market a new type of underground conduit which it claims can be supplied in extra long lengths, thus greatly reducing the number of joints necessary and also cutting down the labor of installation. The conduit consists of a wood fiber tube thoroughly impregnated with pitch and other compounds which experience has shown offer high resistance when placed in the ground or concrete. The conduit is made in the usual standard diameters.

Lightning Arrester Suitable for Outdoor Use.

A type of oxide-film lightning arrester suitable for outdoor use to furnish protection on lines where the voltages range between 1000 and 7500 volts has recently been developed by the General Electric Co., Schenectady, N. Y. It is especially adapted to protecting isolated low-voltage transformer installations of comparatively large capacity, or low-voltage generating plants and substations where lack of attendance or space make the other types of arresters impractical.

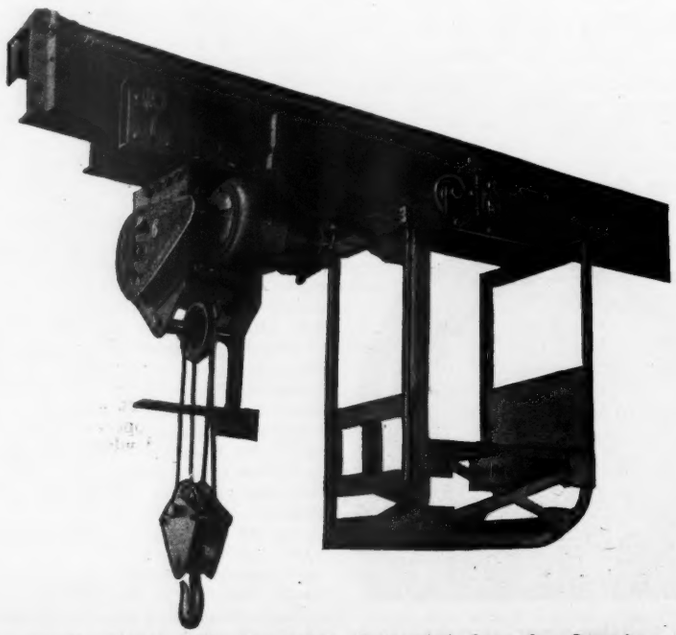
The new oxide-film arrester consists of a stack of oxide cells totally inclosed in a steel case. The spark gaps are also inclosed in this case, which allows the same gap settings for outdoors as would be used indoors. The arresters are made for platform mounting, the size and weights being such that the installation is a fairly simple matter. They require no attention outside of inspection after lightning storms, and a semi-


Oxide-Film Lightning Arrester for Outdoor Service.

annual testing to see that they are in good shape.

Bell Rotary Quenched-Gap Discharger.

The Electric Machine Co., 329 West Ohio street, Indianapolis, Ind., has placed on the market a durable and efficient rotary quenched-gap discharger especially designed for amateur work. The rotary disc contains 6, 8 or 12 electrodes, and is carefully balanced before being mounted into the gap. Four sparking surfaces are used and these are supported by adjustable copper electrodes which can be accurately set from the outside of the casing. The rotor and all insulated parts are made of high dielectric material. The rotating shaft is made of tool steel, hardened and ground to 0.001 in., and turns in bronze bearings. The housing is made of cast aluminum.


Traveling Hoist With Separately Suspended Cage for Operator.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

James W. Poole, Inc., 201 Congress street, Boston, has filed notice of change of name to the Sager Electrical Supply Co.

Morgan-Gardner Electric Co. has announced the removal of the general offices to its plant at 2640 Shields avenue, Chicago.

Northwestern Electric Equipment Co., 35 Vestry street, New York City, has leased the 5-story building at 379 Washington street for a new plant.

Bogert & Carlough Co., Paterson, N. J., has issued catalog D-20, which illustrates and describes the "Boca" solid steel sash for various purposes.

American Rotex Manufacturing Co., Trenton, N. J., has purchased the plant of the Trenton Lamp, Brass & Copper Works and plans to make additions to it.

Habirshaw Electric Cable Co., 10 East 43d street, New York City, manufacturer of electrical cables, etc., has filed notice of increase in its capital stock from $31,500,000 to $33,000,000.

William W. Nugent & Co., 146 West Superior street, Chicago, manufacturer of oiling devices, filtering systems, etc., plans to erect a 2-story plant and equip it with welding furnaces, nickelplating and sheet-metal machinery.

Radio Corp. of America, 233 Broadway, New York City, has announced that the United Fruit Co. has acquired a substantial minority interest in the corporation, and will be represented on the board by George S. Davis, who has been elected a director of the Radio corporation.

National Conduit & Cable Co., 41 Park Row, New York City, with plant at Hastings-on-Hudson, N. Y., has plans under way for reorganization. A stockholders' committee is in charge. At a recent meeting J. J. Watson, G. F. Bauer, O. R. McMahon and E. J. Johnson were elected directors.

Master Electric Co., Dayton, O., manufacturer of electrical specialties, etc., has increased its capital stock from $100,000 to $150,000 for proposed expansion. The officers are: President, E. P. Larsh; vice-president and sales manager, F. O. Kirkpatrick; treasurer, S. A. Brown, and secretary, R. S. Shonk.

Blaw-Knox Co., Pittsburgh, manufacturer of steel products, opened up a new sales territory in the Southwest April 1, with headquarters in Kansas City, Mo. In addition, the company has sales offices in New York, Chicago, Detroit, Boston, Baltimore, San Francisco and Sheffield, Eng. The Kansas City office, which is located in the Interstate building, is in charge of R. B. Randall, formerly connected with the company's Chicago office, who will be known as manager of the Southwestern territory.

Grindle Fuel Equipment Co., formerly known as the Powdered Coal Co., and prior to that as the Combustion Economy Corp., 1901 South Rockwell street, Chicago, has increased its capital stock to $1,000,000 for proposed expansion. The company plans to erect a plant for the manufacture of powdered-coal equipment.

Mitchell-Rand Manufacturing Co., 18 Vesey street, New York City, has issued a 72-page booklet entitled "Everything in Insulation," which contains information on tapes and webbings, varnished materials, varnishes and paints, mica, soldering paste, armature twines, friction tape and splice, vulcanized fiber, carbon and brushes, asbestos, adhesives, insulating waxes and compounds, etc.

Mono Corp. of America, 25 West Broadway, New York City, has issued an illustrated bulletin describing the new "Duplex Mono," an apparatus for reducing fuel costs, making complete boiler plant furnace control possible and giving simultaneous record on one diagram of both the surplus of air in the process of combustion, as well as the degree of incomplete combustion in the same process, due to improper distribution or insufficiency of air supply.

Locomotive Superheater Co., 30 Church street, New York City, has announced that the name of the concern has been changed to The Superheater Co. In making this announcement the company states: "This change has been considered advisable in view of the activity of our organization in the development of superheater equipment for marine, industrial and contracting requirements."

Electric Furnace Construction Co., 908 Chestnut street, Philadelphia, and T. H. Watson & Co., Ltd., Sheffield, England, have announced that arrangements have been made with the General Combustion Co. of Canada, Ltd., New Birks building, Montreal, to handle, build and sell their various electric smelting, melting and refining furnaces in Canada. The Canadian rights of the "Greaves-Etchells" type of furnace, which has been widely adopted in the United States, England, France, Spain, Sweden and other foreign countries, are also included in the arrangements made. The American company will also co-operate with the Canadian company in the supply and installation of the various types of electrically heated core and mold-drying ovens, annealing and heat-treating furnaces, and on electric-furnace problems in general.

Advance Electric Co., St. Louis, manufacturer of motors, generators and motor applications, has announced that it has completed arrangements for sales agencies and offices as follows: Blake Electric Co., 1 Rowes Wharf, Boston; D. J. Vogt, 10718 Amor avenue, Cleveland; W. C. Fletcher, 2439 College avenue, Indianapolis, Ind.; R. R. Caskey, 1120 Conway building, Chicago; William P. Johnson, 8 North Sixth street, Minneapolis, Minn., and W. Irwin Cheyney, 922 Samson street, Philadelphia. The company states that these agents are practical motor men and qualified to give efficient service in their respective territories. They will represent the company both in this respect and as direct sales agents.

Cutler-Hammer Manufacturing Co., Milwaukee, has issued an illustrated booklet, known as publication 2000, which describes the C-H dispatch conveyor adapted for newspaper and magazine publishing plants. It is stated that this conveyor transfers folded newspapers from the printing press to the mailing room over a light steel frame which is carried on the floor or ceiling and will permit turning at any angle. The frame carries sets of grooved pulleys over which run a number of parallel strands of steel spring wire, which support and carry the papers, the pulleys being driven by steel drive chains operated by the press. The delivery is made in a regular manner, irrespective of the speed of the press. Illustrations show installations of the C-H dispatch conveyor in various printing plants, and some of the newspapers and publishing plants using the conveyor are listed.

Bussmann Manufacturing Co., St. Louis, has recently issued an illustrated folder bearing the title, "The Most Remarkable Thing About the Industrial History of the U. S. A.," and containing certain references to the importance of the fuse. The following extracts are taken from the folder: "The most remarkable thing about the industrial history of the U. S. A. is its super-growth. The industrial growth of this country is due to the ever-increasing demand of the public for something bigger and better. Electricity has brought the world industries and comforts that are greater than the wildest dreamer ever imagined. Electricity has set a pace that is fast and furious; those who could not follow had to drop out. The history of a nation lies in the growth and development of electricity. The fuse has always kept in the front rank of electrical progress. As electrical development broadened and branched out, as electrical machines, motors, turbines, dynamos, etc., became an absolute necessity to every-day life it lay before the pioneers of electrical development to produce some apparatus for the protection of millions of dollars of electrical machinery. Here is where the importance of the fuse comes in. The 'Buss' plant has grown from one producing only a few thousand fuses per year to one producing millions annually."

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

R. B. RANDALL has been appointed manager of the Southwestern territory for the Blaw-Knox Co., Pittsburgh, with offices in the Interstate building, Kansas City, Mo.

ROBERT E. RAE has been appointed general manager of the Northwestern Electrical Equipment Co., 35 Vestry street, New York City, electrical supply jobber.

JOHN T. SHARP, JR., manager of the municipal electric light and waterworks plant of Canton, Miss., has been appointed manager of the Winona (Miss.) public utility plant.

J. H. CONNOLLY, who was formerly connected with the N. C. L. Corp., manufacturer of motors, etc., has been appointed general manager of the Capital Motors Corp., Fall River, Mass.

O. B. BARROWS, St. Louis representative of the American Steel & Wire Co., gave a motion-picture address before the St. Louis Electrical Board of Trade recently, in which he showed the manufacture of steel from the ore to the finished product.

A. J. BATES, president of the Bates Expanded Steel Truss Co., 208 South La Salle street, Chicago, left recently for San Francisco, where he will leave on a trip around the world, accompanied by his wife. They expect to be gone 9 mo., and will visit Japan, China and many of the European countries.

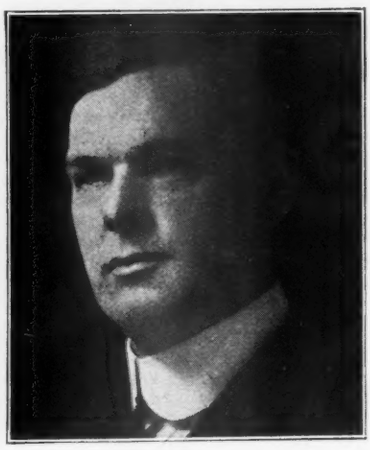
C. S. KENNEDY has been appointed manager of the Otter Tail Power Co., Fergus Falls, Minn., to succeed the late C. B. Kidder. Mr. Kennedy is a graduate in electrical engineering of the Ann Arbor University and previous to his new connection was manager of the Southern Iowa Power Co. He was formerly connected with the South Bend Light & Power Co.

W. W. JOY, who recently became affiliated with the Advance Machinery & Supply Co., Denver, Colo., as vice-president and sales manager, is a graduate of Ames College, Iowa. He is a member of the American Society of Mechanical Engineers and for the past 3 years has been special sales promotion representative for the Fisher Governor Co., Marshalltown, Ia., previous to which he was marine engineer in the U. S. Transport Service during the war. The Advance Machinery & Supply Co. is sales representative for the Betson Plastic Fire Brick Co., the Borromite Co. of America, Connolly Boiler Co., DeLaval Steam Turbine Co., Duryea Manufacturing Co., Eureka hand stokers, Kitts Steam Specialty Co., Lewis M. Ellison draft gages, Farnsworth Co., Fisher Governor Co., Flexible Steel Lacing Co., Garrett Callahan Co., Heine Chimney Co., Ideal Commutator Dresser Co., Jenkins Machine Co., Liptak Firebrick Arch Co., Nelson Valve Co., Ohio Body & Blower Co., Richardson Phoenix Co., Uehling Instrument Co., Viking Pump Co., C. H. Wheeler Manufacturing Co. and the Yarnall-Waring Co.

Y. M. KAREKIN, who was formerly connected with Westinghouse, Church, Kerr & Co. and Dwight P. Robinson & Co., has opened offices at 644 West 173d street, New York City, as a consulting engineer.

JOHN KIERNAN has succeeded William Pollman as president of the Douglas County Light & Water Co., Roseburg, Ore. Other recent appointments by the company include A. G. Sutherland as vice-president to succeed J. B. Yeon, and R. M. Jennings as general manager, secretary and treasurer.

J. B. CRANE, who has recently become connected with the sales and engineering department of the George T.



J. B. Crane.

Ladd Co., Farmers Bank building, Pittsburgh, manufacturer of the Ladd water tube boiler, has had over 15 yrs. experience in the construction and operation of power houses and has a wide acquaintance among public utilities, engineers and mining men in various parts of the country. He is a graduate of Trinity College, class of 1902, and spent several years in the testing department of the General Electric Co. at Schenectady, N. Y., later becoming associated with the Great Northern Power Co. of Duluth, Minn., as commercial manager and superintendent of operation. In 1915 Mr. Crane joined the staff of the Electric Bond & Share Co. of New York City, being engaged in making a power survey for the Appalachian Power Co. in West Virginia. Some time later he went to South America, where he made an investigation of the general power situation in Brazil, Argentina, Paraguay, Uruguay and Chile. For the past 2 yrs. he has been engaged in efficiency studies and service for the W. S. Barstow Management Association and the J. G. White Management Corp. of New York City.

FRANK V. BURTON, who for 30 yrs. has been connected with various branches of the electrical industry and held prominent positions with wiring-device manufacturers, became on April 1 sales manager for Henry D. Sears, general sales agent for Weber wiring devices, 80 Boylston street, Boston. At the age of 17 Mr. Burton established with his brother an electrical supply and contracting business in Albany, N. Y., and 4 yrs. later he joined the supply department of the Western Electric Co. in New York City, where he remained for 7 yrs., during which time he was understudy to such prominent officials as Fred H. Wilkins, Samuel A. Chase, and E. W. Rockafellow. Then followed a connection with Sanderson & Porter, New York City, construction engineers. In the summer of 1902 Mr. Burton joined the forces of the Bryant Electric Co., and during a period of 19 yrs. successively served as sales service manager for 5 yrs., Eastern sales manager for 11 yrs., and general sales manager for 3 yrs. The Bryant catalogs and advertising literature and novelties were the result of his personal work, as well as the addition of a number of wiring devices to the Bryant line. In his new position he will be located in Boston with Mr. Sears, under whose general direction he will be responsible for the sales policy pertaining to the distribution of Weber wiring devices throughout the country.

OBITUARY.

CHARLES A. ROYCE, superintendent of the Consumers Power Co., Muskegon, Mich., died March 27, his death being due to a 40-ft. fall.

CHARLES F. BARTLETT, vice-president of Bartlett & Co., Philadelphia, died recently. He was 73 yrs. old, and had been engaged in the heating business for almost 50 yrs.

DAVID W. PAYNE died recently at his home in Brooklyn, N. Y., at the age of 80 yrs. He was the editor of *Steam*, inventor of the Payne automatic engine and the author of "Foundry Practice."

WILLIAM H. VANDERVOORT, president of the Root & Vandervoort Engineering Co., East Moline, Ill., died recently. He was for a few years professor of mechanical engineering at the University of Illinois, Urbana.

HENRY D. LYMAN, who died in New York City Feb. 27 at the age of 68 yrs., was associated with Col. Jasper N. Keller at Boston in the early days of the development of the telephone in the management of the New England Telephone Co. He joined the Boston forces in 1885, having shortly before retired as Second Postmaster-General. Mr. Lyman at the time of his death was chairman of the board of the American Surety Co., having formerly held the office of president for a period of over 25 yrs., and he was very largely responsible for the upbuilding of this very successful and widely known surety company. Mr. Lyman was a close personal friend of Theodore N. Vail and other eminent telephone pioneers.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Brandon, Vt.—The Hortonia Power Co. is planning the rebuilding of its power plant at Middlebury, Vt., recently destroyed by fire. The new station is estimated to cost $100,000.

Boston, Mass.—Considerable electrical machinery and mechanical equipment will be installed at the car inspection and repair plant to be constructed by the Boston Elevated Railroad Co., Massachusetts avenue, at Forest Hills. The works will consist of a 3-story building, 55 by 500 ft., estimated to cost $500,000 with machinery. Construction will be placed under way at an early date.

Revere, Mass.—The city has completed plans for the construction of a pumping plant at the Point of Pines to cost about $25,000. It will be electrically operated. The city engineer is in charge.

South Braintree, Mass.—Electrical and mechanical equipment will be installed in the factory to be built by the Monatiquot Rubber Works, to replace its plant recently destroyed by fire. The new plant will cost about $200,000.

Wakefield, Mass.—The town of Wakefield recently voted $25,000 for additions to the municipal gas and electric plant. C. W. Whiting, consulting engineer, 148 State street, Boston, has been appointed manager of the plant for a period of 1 yr. It was erroneously reported a few weeks ago that the municipal light plant had been sold.

Worcester, Mass.—Electrical and mechanical equipment will be installed in the 3-story and basement plant to be constructed here by Ashworth Brothers, Inc., Fall River, Mass., manufacturer of textile equipment. It will be 67 by 171 ft., and is estimated to cost $100,000. Machinery will be electrically operated.

New Haven, Conn.—The United Illuminating Co., 84 Temple street, has awarded a contract to C. W. Murdock, Inc., 505 Grand avenue, for the erection of the 1-story addition to its steam power house on Grand avenue, plans for which were recently filed. It will be 69 by 88 ft., and is estimated to cost $40,000.

Pawtucket, R. I.—The Broad Street Power Co. has filed notice of increase in its capital stock from $250 000 to $1,000,000.

Brooklyn, N. Y.—The Brooklyn Edison Co., 360 Pearl street, has made application to the city for permission to extend its 2-story transformer plant on Sumpter street.

Brooklyn, N. Y.—Electrically operated centrifugal pumping machinery and operating mechanism will be used for the new drydock to be installed at the shipyard of Theodore A. Crane Sons' Co., foot of Columbia street. It will be built in four sections and have a capacity of handling vessels up to 500 ft. in length and with gross tonnage of 11,000 tons.

Delhi, N. Y.—The DeLancey Electric Light Co. has made application to the Public Service Commission for permission to construct an electric power plant at DeLancey, and for approval of a franchise granted by this municipality.

Far Rockaway, L. I., N. Y.—The Queens Borough Gas & Electric Co. has acquired the block front at Beach and 53d street, Edgemere, L. I., and has plans under way for the erection of a large service and general power station on the site.

New York, N. Y.—The New York Edison Co., 130 East 15th street, has awarded a contract to the Goodwin Construction Co., 130 Fourth street, for the erection of its proposed 3-story electric substation, 50 by 100 ft., at 159-61 Greene street, to cost about $160,000.

New York, N. Y.—The Public Service Commission has granted permission to the New York Telephone Co. to increase its local rates for service approximately 28%, effective April 1. The order requires the company to file a bond of $11,000,000 with the commission, and which sum, it is estimated, will be provided annually by the increase.

New York, N. Y.—The New York Edison Co. will furnish service for the Bowling Green central office of the New York Telephone Co., 104 Broad street, to be equipped with electrically operated automatic switching apparatus. The power requirements will consist of 1500 lamps and 1255 hp. for the operation of the various motors and automatic switchboard.

New York, N. Y.—The American Gas & Electric Co., 30 Church street, is having plans prepared in its engineering department for the proposed power plant addition for its subsidiary organization, the Atlantic City Electric Co., Atlantic City, N. J. The station will be located on Tennessee avenue and is estimated to cost $800,000 with equipment.

New York, N. Y.—The Consolidated Telegraph & Electric Subway Co., 54 Lafayette street, will install an electric traveling crane at its property at 535-51 West 41st street. The Heddon Iron Construction Co., 30 Church street, has the contract for runways and other steel work.

New York, N. Y.—The New York Edison Co. has been granted an order by the Appellate Division of the Supreme Court, staying the injunction recently secured by the city forbidding the company and the United Electric Light & Power Co. from collecting increased rates for light and power, as recently granted by the Public Service Commission. The two utilities agree to deposit all sums collected in excess of the regular rate of $0.07 per kw-hr. heretofore operative, leaving such in escrow until a final decision is rendered in the case by the higher court.

Old Forge, N. Y.—The village has petitioned the State Public Service Commission for permisison to build, maintain and operate an electric light plant in the village.

Potsdam, N. Y.—The St. Lawrence Transmission Co. has plans under way for the construction of its proposed transmission system in the vicinity of Tupper Lake, N. Y., estimated to cost $30,000. F. A. Stroughton is president.

Tottenville, S. I., N. Y.—The Staten Island Civic League is directing activities to make possible the proposed municipal electric power plant at the St. George Ferry Terminal, now being considered by the Board of Estimates, Manhattan, in accordance with recent recommendations of Grover A. Whalen, commissioner of plants and structures. The new plant as now projected is estimated to cost $1,000,000.

Waterford, N. Y.—The Northern Adirondack Power Co. has been ordered by the Public Service Commission to complete its power plant at Au Sable Chasm, install new switchboard, switching and other electrical equipment; construct a substation at Au Sable Forks, and make a number of extensions and improvements in its transmission and distributing system. Thomas O'Connor is president.

West Burlington, N. Y.—D. Thorne Gardner has petitioned the State Public Service Commission for permission to construct an electric light plant in portions of the towns of Burlington and Edmeston, N. Y.

Jersey City, N. J.—Electrical machinery and mechanical equipment will be installed in the new plant of the M. W. Kellogg Co., 117 Westside avenue, to be located on Hackensack avenue. The plant will be used for the manufacture of steel pipe, fittings, power plant equipment and kindred apparatus, including large penstocks for electric power plant service. Plans have been filed for the initial buildings to consist of a 1-story welding shop to cost $73,500; 1-story plate and rolling mill to cost $47,250; and 1-story steel construction shop to cost about $44,000. The entire plant will include a site of 42 acres, and is estimated to cost in excess of $2,500,000 A number of electric traveling cranes will be installed.

Newark, N. J.—Electrical equipment for the operation of precision machinery and other service will be installed in the jewelry manufacturing plant to be erected by Barrasso &

Blasi, Inc., 112 Arlington street, at Governor and Marion streets. The plant is estimated to cost $35,000.

Trenton, N. J.—A bill is being considered by the State Legislature now in session to permit the State Sanitarium at Glen Gardner to sell excess electrical energy from its power plant to different consumers in Glen Gardner and Hampton.

New Castle, Del.—The City Council has adopted resolutions giving the municipality authority to purchase the present lighting system, with waterworks system. Bonds for $100,000 will be provided for this purpose. It is planned to take over the lines on April 1. A number of improvements and extensions are contemplated.

Wilmington, Del.—Property owners on King street are negotiating with the city for the installation of an improved lighting system along the thoroughfare.

Allentown, Pa.—The Lynn Township Light & Power Co. and the Wessenburg Township Light & Power Co. recently organized, are planning the installation and operation of electric systems in Lynn and Wessenburg townships, respectively.

College Hill, Pa.—The Hill Light Co. has been incorporated with a nominal capital of $5000 to operate a local light and power system. C. J. Braun, Jr., 635 Sixth avenue, Pittsburgh, is treasurer. Plans are under way for the installation of a system.

Elizabethtown, Pa.—The Hershey (Pa.) Traction Co. has completed plans for the construction of an electric power plant at Conewago Creek, near Elizabethtown, for increased power supply for traction service.

Erie, Pa.—The Erie Electric Lighting Co. and the C. D. Electric Co. have made application to the Public Service Commission for permission for a merger of interests.

Philadelphia, Pa.—Plans for extensions and improvements to its power house have been filed by the Abbott's Alderney Dairies, Lombard street.

Philadelphia, Pa.—The Reyburn Manufacturing Co., 32d street and Allegheny avenue, has filed plans for the construction of a 1-story power house at its tag manufacturing plant to cost about $25,000.

Philadelphia, Pa.—Electrical and mechanical equipment will be installed by the Bureau of Water, Department of Public Works, City Hall, at its proposed 1-story machine and repair shop, 160 by 200 ft., to be located at 28th and Clearfield streets. Preliminary plans are being prepared.

Scranton, Pa.—The Hudson Coal Co., Union National Bank building, is planning the rebuilding of the electric power plant at its Coalbrook colliery, near Scranton, recently destroyed by fire with a loss estimated at $80,000.

Baltimore, Md.—The Chesapeake & Potomac Telephone Co. will spend $10,000,000 for an additional plant to take care of the increasing needs in Baltimore before the close of 1923.

Baltimore, Md.—The Consolidated Gas, Electric Light & Power Co. has made a working agreement for certain interchange of service with the Bel Air (Md.) Electric Co., and the contract has been submitted to the Public Service Commission for approval.

Baltimore, Md.—The Northern Maryland Electric Co. has been granted permission by the Public Service Commission to extend its system in certain portions of Cecil county, including the Rising Sun district. The County Commissioners have approved the extensions.

Baltimore, Md.—The United Railways Co. has submitted a statement to the City Electrical Commission to the effect that it is planning to expend $100,000 a year for the installation of underground feeder lines in different parts of the city. Streets as now outlined by the commission, it is set forth, would be cleared of overhead lines, within 24 mo.

Baltimore, Md.—The American Sugar Refining Co. has filed plans for the erection of a 1-story power house, 110 by 130 ft., at Woodall and Clement streets. Stone & Webster, Boston, are engineers.

Canton, Md.—The Standard Oil Co. has completed plans for the construction of a 1-story power house at its plant, 93 by 142 ft., to cost about $50,000.

Chatham, Va.—The Chatham Light & Power Co., recently incorporated with a capital of $25,000, will install a power unit. Address T. Ryland Sanford.

Coleman Falls, Va.—The Bedford Pulp & Paper Co. of Richmond, Va., plans to erect an additional power unit.

Grundy, Va.—The Lambert Light & Power Co. has been incorporated with a capital of $25,000. Address J. W. Lambert, president.

Norfolk, Va.—The city will install a lighting system on Bank street, from Main to Queen streets, at a cost of $12,000. Address City Commissioners.

Norfolk, Va.—Electrical and mechanical equipment will be installed by the Virginian Railroad Co., at its proposed new shops and engine house at Elmore, W. Va., estimated to cost $40,000.

Quantico, Va.—The U. S. Government, C. W. Parks, chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., will erect electric light and power plant here.

Romney, W. Va.—The Romney Power Co. has applied for permission to construct a dam across the south branch of the Potomac river for the purpose of generating electricity by water power for use in this section.

Charlotte, N. C.—The Southern Power Co. plans to construct a $10,000 power plant on Mountain Island and increase its capacity to supply electrical energy to additional manufacturing establishments.

Cornelius, N. C.—Electric light bonds to the amount of $10,000 will be offered for sale April 18. Address T. P. Howard, town clerk.

Hickory, N. C.—The United Mills Co. is perfecting plans for the construction of its proposed hydroelectric plant at Lenoir, N. C., to be used for textile mill and other service. The plant will be located on Harpers creek.

Madison, N. C.—The Town Council has authorized a bond issue of $30,000 for the installation of an electric lighting system. P. H. Scales is town treasurer.

Charleston, S. C.—Charleston Consolidated Railway, Gas & Electric Co., has filed notice of increase in its capital stock to $5,500,000 for expansion. C. J. Bendt is secretary-treasurer.

Newberry, S. C.—The City Council is planning extensions in the electric lighting system; a number of improvements in present lines will be made.

Rock Hill, S. C.—The Rock Hill Telephone Co. will lay conduits for underground cables and improve its system generally.

Alma, Ga.—The city desires to get in touch with engineers and contractors with reference to the installation of an electric light plant. Address J. H. McDonald, city clerk.

Reynolds, Ga.—The City Council has perfected arrangements for the installation of an electric lighting system to be operated in conjunction with a municipal waterworks, estimated to cost $40,000.

Fort Lauderdale, Fla.—The Southern Utilities Co. is preparing to extend its lighting system to Las Olas Beach and Idlewyld.

Marianna, Fla.—The City Council plans to install pumping equipment and a motor capable of lifting water 150 ft. high from the surface. Address J. C. Davis, president.

NORTH CENTRAL STATES.

North Jackson, O.—The North Jackson Light, Heat, Power & Water Co. has been incorporated with a capital stock of $10,000, the incorporators being N. Shipley, S. T. Stewart, G. L. McMillin and others.

Sidney, O.—The Sidney telephone exchange was recently destroyed by fire, causing a loss of about $200,000.

Springfield, O.—The city has appropriated $19,700 for the extension of the park system and other expenses, $10,000 of which will be used for changing and extending the lighting system in Snyder park.

Marysville, Mich.—The Detroit Edison Co. will erect a substation and transmission lines. Address Alex. Dow, David Whitney building, Marysville.

Ovid, Mich.—For the purpose of installing boilers in the municipal light plant $12,000 has been voted. Address E. C. Smith, president of the village board.

Union City, Mich.—The city has voted $150,000 for the purpose of developing power on the St. Joseph river, 4 mi. west of here. Electric power is now used for both the city water and lighting plants.

Belleville, Ill.—The West Side Improvement Association has recommended that steps be taken to have the wires on East Main street placed

in underground conduits, thereby eliminating the necessity for poles.

Champaign, Ill.—The City Commissioners have passed a lighting ordinance providing for a lighting system for the business district of the city.

Peoria, Ill.—The Peoria & Chillicothe Electric Railroad Co. seeks an extension of its franchise to use the streets of the city until March 14, 1923, in an ordinance amending the original ordinance granting a franchise which was passed by the City Council Sept. 12, 1916.

Sterling, Ill.—The special committee, of which Mr. Tennant is chairman, secured the aid of a lighting specialist who has investigated the needs of the city in the way of boulevard lighting improvements and extensions. A complete report, covering recommendations and estimates, is expected shortly.

Waltonville, Ill.—The Illinois Public Utilities Commission has before it an application from the Southern Illinois Light & Power Co., Hillsboro, Ill., to put in an electric plant at Waltonville, Ill., and construct and operate a transmission line between Duquoin and Mt. Vernon.

White Hall, Ill.—An underground system for lighting the streets has been installed and ornamental posts have also been erected.

Manning, Ia.—Plans have been prepared by K. C. Gaynor, Trimble block, Sioux City, Ia., engineer, for an electric light plant. Address P. H. Jones, city clerk.

Kansas City, Mo.—The Western Tablet Co., Mitchell and 11th streets, plans to erect a 1-story power house, 40 by 100 ft., at an estimated cost of $35,000.

Ellinwood, Kan.—An election will be held April 4 to vote on the question of issuing $40,000 water and light improvement bonds. Address the mayor.

Morganville, Kan.—The City Council is having plans prepared for the construction of a transmission line and installation of a local distributing system. The work is estimated to cost $25,000. W. B. Rollins & Co., 209 Railway Exchange building, Kansas City, Mo., are engineers.

Osborne, Kan.—Plans have been prepared by E. T. Archer & Co., 609 New England building, Kansas City, Mo., engineers, for the erection of a power plant for the city. Address S. P. Crampton, city clerk.

Gordon, Neb.—The city will start work on its electric light plant shortly. Address city clerk.

SOUTH CENTRAL STATES.

Burnside, Ky.—Application has been made to the Federal Power Commission for a license to develop water-power projects 1.5 mi. from this city. The upper dam creates a reservoir 16 mi. to Williamsburg in McCreary, Pulaski and Whitley counties. Address J. S. Wallace.

Dawson Springs, Ky.—The federal government plans to construct a power house at this place.

Harrodsburg, Ky.—The Common Council will soon ask for bids for its proposed municipal electric power plant to be operated in connection with the waterworks system. The project is estimated to cost $100,000. Address J. G. Pulliam, mayor.

Birmingham, Ala.—The Alabama Power Co. has plans under way for the installation of an additional generating unit at its power plant on the Coosa river, to furnish a total of 19,500 hp. The new unit with auxiliary operating equipment is estimated to cost $500,000. W. N. Walmsley is vice-president and general manager.

Dothan, Ala.—The city has voted $750,000 bonds for the establishment of an electric lighting and power plant. Address R. O. Lisenby, city clerk.

Greensboro, Ala.—The city authorities have arranged for a lease of the local lighting system to be operated as municipal property. A number of extensions and improvements are planned.

Meridian, Miss.—The Western Union Telegraph Co. will expend $35,000 on plant extensions and improvements.

Mount Olive, Miss.—The Common Council is planning extensions and improvements in the municipal electric plant, including the installation of new equipment.

Pascagoula, Miss.—The citizens have voted $125,000 6 per cent electric and water bonds. Address the mayor.

Wesson, Miss.—The Knapp Co. has entered into a contract with the city to take over the Wesson electric light and water plant and will furnish the town with the necessary lights and water.

Cotter, Ark.—The Dixie Power Co. has been granted permission to construct a hydroelectric generating station on the White river, near Cotter. Engineers propose to build a high dam and back up the water on the river for 100 mi. to produce 100,000 hp. to be transmitted to cities in Arkansas, Oklahoma and Missouri. Address Walker V. Powell, president.

WESTERN STATES.

Dixonville, Ore.—Application has been made by S. W. Leake for permission to use water from the north branch of Deer creek for irrigating, power and lighting purposes.

Los Angeles, Cal.—A $25,000,000 bond issue will be submitted to the voters for the development of hydroelectric power from the Owens river valley. Address Chief Engineer Scattergood.

Pasadena, Cal.—An election will be held April 7 to vote on the question of issuing $350,000 municipal light bonds. Address city clerk.

Pasadena, Cal.—Bonds to the amount of $415,000 have been voted for a municipal light department. Address city clerk.

Tracy, Cal.—Electroliers are to be placed on Fourth, Sixth and all of Eleventh street at a cost of $200,000.

CANADA.

Toronto, Ont.—The Canadian General Electric Co., 212 King street West, plans to erect a power house at Peterboro, Ont.

INCORPORATIONS.

Jamaica, Long Island, N. Y.—Jamaica Electric Service & Equipment Corp. Capital, $10,000. To manufacture electrical appliances and equipment. Incorporators: P. and P. J. and K. Guthy.

New Rochelle, N. Y.—George B. Banks, Inc. Capital, $100,000. To manufacture electrical machinery. Incorporators: F. G. Schrenkeisen, and A. D. and G. B. Bank, 320 Fifth avenue.

Chicago, Ill.—American Lighting & Manufacturing Co., 800 Sibley street. Capital, $100,000. To manufacture electric lighting equipment and appliances. Incorporators: W. J. Davis, F. E. Davis and W. O. Turtle, 811 Sheridan road.

Hartford, Conn. — Corbit - Craig Equipment Co. Capital, $50,000. To manufacture headlight controllers, etc. Incorporators: L. H. Corbit, Bridgeport, Conn., G. M. Hanchett, R. G. Rockwell and others.

Belleville, N. J.—Sanford Electric Corp. Capital, $250,000. To manufacture electrical appliances. Incorporators: J. B. Kellogg, George C. Study and Lester C. Burdett.

Wilmington, Del.—Automatic Electrical Machine Co. Capital, $500,000. To manufacture electrical machinery. Incorporators: C. B. Outten, C. T. Cohee and S. L. Mackey.

Enid, Okla.—University Battery & Electric Co. Capital, $100,000. To manufacture electric batteries and other equipment. Incorporators: G. E. Darland, I. F. Conkling and C. P. Harris.

Toronto, Ont.—Master Spark Plug Co., Ltd. Capital, $125,000. To manufacture spark plugs, etc. Incorporators: Thomas A. Henderson, Percy J. Lynn and Stanley M. Clapp.

Los Angeles, Cal.—Pacific Lighting Fixture Co. Capital, $25,000. To manufacture electric lighting fixtures. Incorporators: C. E. Merryweather, W. F. Brandes, S. G. Ulmer and R. J. Gardner, 803 Van Nuys building.

PROPOSALS.

Hallettsville, Tex.—Bids will be received April 14 for improvements to the light plant, including the furnishing of one steam engine, one horizontal return tubular boiler, one 150 hp. open type feed-water heater, etc. Address S. M. Kuykendall, city secretary.

Rocky River, O.—Bids will be received April 5 for constructing an extension to the present street-lighting system on Frazier street. Address Frank Mitchell, city clerk.

Fredericksburg, Tex.—Bids will be received for rebuilding burned plant of the Fredericksburg Light & Power Co. Address H. A. Ries, manager of the Citizens Committee.

Oconomowoc, Wis.—Bids will be received April 4 for electrical equipment for street lighting system. Address F. R. Hubbard, superintendent of the light department.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Canadian General Electric Co.'s Earnings for 1920.

Earnings of the Canadian General Electric Co., Ltd., for 1920 were $1,356,689, equal to $15.07 on the $9,000,000 common stock outstanding, compared with $1,093,321, equal to $12.15 a share, in 1919. After all other provisions, including dividends, the company was able to carry to profit and loss surplus $342,575, compared with $313,321 in 1919. The company will pay a stock bonus of 20% to stockholders. Surplus current assets over current liabilities, including mortgage indebtedness, was $6,782,964, against $7,353,067 in 1919.

Winnipeg Electric Railway Co.

Income account of the Winnipeg Electric Railway Co. for the year ended Dec. 31, 1920, compares as follows:

	1920.	1919.
Gross earnings	$5,233,701	$4,284,479
Net operating revenue	1,804,803	1,264,984
Gross income	1,881,503	1,323,623
Surplus after depreciation, taxes and charges	595,525	96,805

Benjamin Electric Manufacturing Co.

For the year ended Dec. 31, 1920:

Profits after deducting inventory losses, but before deducting federal taxes for the year, were	$432,064
Refund on 1917 taxes	8,566
Less Dividends	150,717
Federal taxes paid for 1919	59,975
Sundry adjustments	937
Previous surplus	655,773
Total surplus Dec. 31	884,773

Cumberland County Power & Light Co.

	1920.	1919.
December gross	$ 286,088	$ 262,658
Net after taxes	94,627	127,528
Surplus after charges	38,566	71,865
Twelve months' gross	3,114,008	2,768,600
Net after taxes	971,174	954,666
Surplus after charges	303,691	282,414

Western States Gas & Electric Co.

The gross and net earnings of the Western States Gas & Electric Co. for the years ended Jan. 31, 1921, and 1920, are reported as follows:

	1921.	1920.
Gross earnings	$2,258,198	$1,926,378
Net earnings	817,484	785,793

General Gas & Electric Co.'s Subsidiaries.

	1921.	1920.
January gross	$1,015,382	$ 920,602
Net after taxes	254,618	261,853
Twelve months' gross	11,459,346	9,311,660
Net after taxes	2,384,731	2,712,899

Arkansas Valley Railway, Light & Power Co.

Gross and net earnings of the Arkansas Valley Railway, Light & Power Co. for the 12 mo. ended Jan. 31, 1921, compared with the corresponding previous 12 mo. period are reported as follows:

	1921.	1920.
Gross earnings	$1,875,975	$1,596 982
Net earnings	604,675	545,083

Southern California Edison Co.

	1920.	1919.
Month of December:		
Gross earnings	$1,208,654.69	$ 899,744.90
Expenses and taxes	*769,653.98	445,268.50
Net earnings	439,000.71	454,476.40
Fixed charges	270,527.22	253,772.34
Balance	168,473.49	200,704.06
12 mo. ended Dec. 31. 1920:		
Gross earnings	14,647,896.32	10,569,564.75
Expenses and taxes	*6,413,684.52	4,480,321.06
Net earnings	8,234,211.80	6,089,243.69
Fixed charges	3,162,416.42	3,106,060.99
Balance	5,071,795.38	2,983,182.70

*Taxes include provision for 1920 income tax.

Net Income of New England T. & T. Co. Shows Gain.

The New England Telegraph & Telephone Co., a New York corporation, has filed notice of increase in its capital stock from $75,000,000 to $100,000,000. The company reports a net income for the year ending Dec. 31, 1920, of $6,137,545, as against $5,424,934 in the preceding year.

Cities Service Co.

	1921.	1920.
February gross	$1,442,699	$2,111,764
Net earnings	1,384,131	2,049,918
Surplus after interest charges	1,206,229	1,881,269
Balance after preferred dividends	804,234	1,499,512
Twelve months' gross	23,760,214	20,374,222
Net earnings	23,049,367	19,675,383
Surplus after interest charges	21,109,679	17,685,417
Balance after preferred dividends	16,382,372	13,388,863

Portland Railway, Light & Power Co.

	1921.	1920.
January gross	$ 893,235	$ 768,808
Net after taxes	289,954	251,472
Surplus after interest charges	120,525	75,363
Twelve months' gross	9,689,042	8,656,262
Net after taxes	2,929,783	2,955,428
Surplus after interest charges	2,832,005	834,065

Note.—Included in operating expenses in January, 1921, $59,782; January, 1920, $23,064; 12 mo., 1921, $678,720; 12 mo., 1920, $259,685 for depreciation.

Nashville Railway & Light Co.

	1921.	1920.
January gross	$ 334,627	$ 306,903
Net after taxes	87,113	76,980
Surplus after interest charges	47,240	36,860
Twelve months' gross	3,702,933	3,258,970
Net after taxes	706,009	783,782
Surplus after interest charges	226,931	308,457
Balance after preferred dividends	101,931	183,457

Tennessee Railway, Light & Power Co. and Subsidiaries.

(Railway department of Chattanooga Railway & Light Co. excluded.)

	1920.	1919.
December gross	$ 582,420	$ 522,252
Net after taxes	160,876	173,160
Twelve months' gross	6,441,011	5,587,849
Net after taxes	2,118,852	2,054,306

New England Co. Power System.

	1920.	1919.
December gross	$ 517,846	$ 498,941
Net after taxes	237,373	146,975
Surplus after charges	159,324	80,936
Twelve months' gross	5,956,444	4,218,967
Net after taxes	1,676,207	1,512,088
Surplus after charges	863,267	747,362

Western Union Telegraph Co.

	1920.	1919.
December operating revenue	$9,619,643	$9,490,048
Net after expenses	1,394.460	199,778
Operating income	1,328,354	*759,045
Twelve months' operating revenue	119,991,825	102 577.814
Net after expenses	21,483,234	23,185,388
Operating income	16,986,267	17,770,903

*Deficit.

Dividends.

	Term.	Rate.	Payable.
Cities Service, com	M	0.5%	May 1
Cities Service, pfd	M	0.5%	May 1
Cities Service, pfd. "B"	M	0.5%	May 1
Cities Service, com. stk.	M	1.25%	May 1
Detroit Edison Co	Q	2%	Apr. 25
Duquesne Lt., pfd	Q	1.75%	May 2
Elec. Stor. Btry., com	Q	3%	Apr. 1
Elec. Stor. Btry., pfd	Q	3%	Apr. 1
Philadelphia Co., com	Q	$0.75	Apr. 30
Philadelphia Co., pfd. SA		$1.50	May 2
United Gas Imp., com	Q	1%	Apr. 15
United Gas Imp., pfd	Q	1.75%	June 15
Westing. Elec		$19	Apr. 30
Westing. Elec., pfd	Q	$1	Apr. 15
Westing. Air Brake	Q	$1.75	Apr. 30
West. Penn. Pr., pfd	Q	1.75%	May 2
West. Penn. Tr. & W. Pr., pfd	Q	1.5%	May 16
West. Penn. Tr. & W. Pr., pfd. accum.		1.25%	May 16

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Mar. 22.	Bid Mar. 29.
Adirondack Electric Power of Glenns Falls, common	6	14	14
Adirondack Electric Power of Glenns Falls, preferred	6	71	71
American Gas & Electric of New York, common	..	101	102
American Gas & Electric of New York, preferred	6	36½	37½
American Light & Traction of New York, common	..	103	101
American Light & Traction of New York, preferred	6	82	82
American Power & Light of New York, common	4	50	49
American Power & Light of New York, preferred	6	69	70
American Public Utilities of Grand Rapids, common	..	7	7
American Public Utilities of Grand Rapids, preferred	7	17	17
American Telephone & Telegraph of New York	..	101	100
American Water Works & Elec. of New York, common	..	4	4
American Water Works & Elec. of New York, particip	7	6½	7
American Water Works & Elec. of New York, 1st preferred	..	42	44
Appalachian Power, common	..	3	3
Appalachian Power, preferred	7	24	24
Cities Service of New York, common	+extra	231	250
Cities Service of New York, preferred	6	66½	67½
Commonwealth Edison of Chicago	8	108	107
Comm. Power, Railway & Light of Jackson, common	..	13	13
Comm. Power, Railway & Light of Jackson, preferred	6	35	34
Federal Light & Traction of New York, common	..	6½	6½
Federal Light & Traction of New York, preferred	..	42	42
Northern States Power of Chicago, common	..	46	47
Northern States Power of Chicago, preferred	ex.div.7	79	79
Pacific Gas & Electric of San Francisco, common	..	47	46
Public Service of Northern Illinois, Chicago, common	7	76	75
Public Service of Northern Illinois, Chicago, preferred	6	80	82
Standard Gas & Electric of Chicago, common	..	11	10½
Standard Gas & Electric of Chicago, preferred	8	34	34½
Tennessee Railway, Light & Power of Chattanooga, common	..	1	¾
Tennessee Railway, Light & Power of Chattanooga, preferred	6	5	5½
Western Power of San Francisco, common	..	24	24
Western Union Telegraph of New York	..	88	89
Industrials—			
Electric Storage Battery of Philadelphia, common	4	98	97
General Electric of Schenectady	8	135	136
Westinghouse Electric & Mfg. of Pittsburgh, common	7	47	47½